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Data Analysis of 1986 and 1987 Hecate Strait Juvenile Salmon Surveys

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ABSTRACT

Waddell, B. J., M. C. Healey and J. F. T. Morris. 1989. Data analysis of 1986 and 1987 Hecate Strait juvenile salmon surveys. Can. Tech. Rep. Fish. Aquat. Sci. 1719: 65 p.

Juvenile salmon were collected by purse seiners during 5 surveys in the southern area of Hecate Strait in July and August of 1986 and 1987 (Morris and Healey 1987, 1988). Sampling took place at pre-determined distances along several transect lines at right angles to the coast, and in sheltered channels. Pink salmon, (Onchorynchus gorbuscha), were the most abundant catch, followed by chum (O. keta), then coho (O. kisutch) and sockeye (O. nerka). Only a few chinook (O. tshawytscha) were captured, and were therefore, not included in the analyses. The data were analyzed for sex ratios, size composition, length-weight relationships, and interspecific correlations of size and catch rate among purse seine sets.

There were no significant differences between male and female percentages of any species in either 1986 or 1987 at the 0.05 level of significance, but at the 0.10 level of significance there were more male sockeye than female sockeye during Cruise 1, 1986 and fewer male chum than female chum in Cruise 1 and 2, 1986 (combined).

The 1986 formalin-preserved pink, chum and coho had significantly greater length-weight regression line slopes than the frozen salmon of their respective species. There were no significant differences between male and female length-weight regression lines for any species in 1986 or 1987. The 1986 frozen pink salmon had the significantly largest length-weight regression line slope of all 1986 frozen fish, while the slope of 1986 formalin-preserved pink was not significantly different than the slope of 1986 formalin-preserved chum. The 1986 sockeye and coho had the smallest regression line slopes for both preservation methods, and were not significantly different from each other. Chum salmon had the largest regression line slope of all other species in 1987. The 1986 formalin-preserved pink, chum and coho had significantly greater length-weight regression line slopes than their respective species in 1987.

Mean fork lengths of all species were significantly larger in Cruise 2 than in Cruise 1 in 1986. In 1987, the mean fork lengths were significantly largest during Cruise 2 for all species, followed by Cruise 3 and then Cruise 1 (except for sockeye and coho, for which there were no significant differences between Cruise 2 and 3). Mean fork lengths were significantly different between the various distances offshore, but there was no general pattern of sampling location influence on the mean fork lengths for any of the species except 1986 coho. Mean fork lengths of these fish increased with the distance offshore. Cruise x distance offshore interactions were highly significant for pink salmon in 1986 and 1987, for chum in 1986, and for sockeye and coho in 1987.

Correlation coefficients were calculated to determine whether there were size correlations between species within individual purse seine sets. The majority of the size correlations were positive, and all of the significant correlations (25%) were positive. Significant size correlations existed between pink and chum in Cruise 1 and Cruise 2, 1986 and Cruise 1 and Cruise 2 & 3, 1987, between chum and sockeye in Cruise 2, 1986, chum and coho in Cruise 1, 1986 and between sockeye and coho in Cruise 2, 1986. In general, there was a high size correlation within the sets, regardless of the species (i.e. small salmon of 'species A' were caught with small salmon of 'species B', large salmon of 'species A' were caught with 'species B', etc.).

Correlation coefficients were also calculated to determine whether some species tend to be captured together, while other species tend to be segregated. There were significant, positive correlations between the capture of pink and chum salmon in Cruise 1 and Cruise 2, 1986 and in Cruise 1, 1987, between the capture of pink and sockeye in all cruises in both sampling years, and between the capture of chum and sockeye salmon during all cruises in both years. There was a significant, negative correlation between the capture of coho and sockeye during Cruise 1, 1986. The significant, positive correlations occurred in both years (except pink and chum in Cruises 2 & 3 combined, 1987) suggesting that interspecific associations within Hecate Strait, especially positive correlations, were relatively consistent each year.

RÉSUMÉ

Waddell, B. J., M. C. Healey and J. F. T. Morris. 1989. Data analysis of 1986 and 1987 Hecate Strait juvenile salmon surveys. Can. Tech. Rep. Fish. Aquat. Sci. 1719: 65 p.

Des saumons juvéniles ont été capturés à la senne coulissante au cours de 5 relevés réalisés dans la partie sud du détroit d'Hécate en juillet et août 1986 et 1987 (Morris et Healey 1987, 1988). L'échantillonnage a eu lieu à des distances prédéterminées le long de quelques transects à angle droit de la côte et dans des canaux abrités. Les prises étaient constituées des espèces de saumon suivantes, par ordre décroissant d'importance: saumon rose (Oncorhynchus gorbuscha), saumon kéta (O. keta), saumon coho (O. kisutch) et saumon nerka (O. nerka). Seuls quelques saumons quinnat (O. tshawytscha) ont été capturés; c'est pourquoi ils n'ont pas été inclus dans les analyses. Les données ont été analysées pour déterminer les sex-ratios, la composition en fonction de la taille, les relations longueur-poids, et les corrélations interspécifiques concernant la taille et le taux de capture selon les traits.

Il n'y avait pas de différence statistiquement significative entre les pourcentages de mâles et de femelles pour chacune des espèces en 1986 ou 1987 au seuil de signification de 0,05, mais au seuil de signification de 0,10 il y avait dans le cas du saumon nerka, plus de mâles que de femelles durant la campagne 1 de 1986 et, dans le cas du saumon kéta, moins de mâles que de femelles au cours des campagnes 1 et 2 de 1986 (combinées).

Si l'on compare les saumons roses, kéta et coho de 1986 conservés dans la formaline aux saumons de ces mêmes espèces, mais cette fois congelés, les pentes de régression longueur-poids étaient significativement plus grandes dans le cas des premiers. Il n'y avait pas de différence significative entre les lignes de régression longueur-poids pour les mâles et les femelles chez aucune des espèces en 1986 ou 1987. Le saumon rose congelé de 1986 a présenté la pente de régression longueur-poids la plus importante de tous les poissons congelés de 1986, tandis que la pente du saumon rose de 1986 conservée dans la formaline n'était pas différente, de manière statistiquement significative, de la pente du saumon kéta de 1986 conservé dans la formaline. Les saumons nerka et coho de 1986 avaient les pentes de régression les plus faibles dans le cas des deux méthodes de conservation, et ces dernières n'étaient pas statistiquement différentes l'une de l'autre. Le saumon kéta a présenté la pente de régression la plus importante de toutes les espèces en 1987. Dans le cas des saumons roses, kéta et coho conservés dans la formaline, les pentes de régression longueur-poids ont été plus importantes en 1986 qu'en 1987.

En 1986, les longueurs moyennes à la fourche chez toutes les espèces ont été statistiquement plus grandes au cours de la campagne 2 que de la campagne 1. En 1987, c'est durant le campagne 2 que les longueurs moyennes à la fourche ont été les plus grandes et ce, pour toutes les espèces; viennent ensuite les campagnes 3 et 1 (sauf pour les saumons nerka et coho, pour

lesquels il n'y avait pas de différence statistiquement significative entre les campagnes 2 et 3). Les longueurs moyennes à la fourche ont été différentes, de manière statistiquement significative, selon la distance par rapport à la côte, mais on n'a rien décelé qui indiquerait une influence du lieu d'échantillonnage sur les longueurs moyennes à la fourche des différentes espèces, sauf le saumon coho de 1986. Les longueurs moyennes à la fourche de ces poissons ont augmenté en fonction de la distance par rapport à la côte. Les interactions campagne x distance de la côte se sont révélées hautement significatives dans le cas du saumon rose en 1986 et 1987, dans celui du saumon kéta en 1986 et dans celui des saumons nerka et coho en 1987.

Des coefficients de corrélation ont été calculés pour déterminer s'il y avait des corrélations relatives à la taille entre les espèces à l'intérieur des traits individuels pratiqués à la senne coulissante. La plupart des corrélations relatives à la taille étaient positives, ce qui est également le cas de toutes les corrélations statistiquement significatives (25 %). Des corrélations statistiquement significative existaient entre le saumon rose et le saumon kéta au cours des campagnes 1 et 2 de 1986 et des campagnes 1 ainsi que 2 et 3 de 1987, entre le saumon kéta et le saumon nerka dans la campagne 2 de 1986, entre le saumon kéta et le saumon coho de la campagne 1 de 1986 et entre les saumons nerka et coho de la campagne 2 de 1986. En général, il y avait une forte corrélation avec la taille à l'intérieur des traits, quelle que soit l'espèce (par exemple, les petits saumons de l'espèce A ont été capturés avec des petits saumons de l'espèce B, les gros saumons de l'espèce A ont été capturés avec des gros saumons de l'espèce B, etc.).

Des coefficients de corrélation ont également été calculés pour déterminer si certaines espèces avaient tendance à être capturées ensemble et d'autres, à être capturées séparément. On a observé des corrélations positives significatives en ce qui concerne la capture des saumons roses et kéta au cours des campagnes 1 et 2 de 1986 et de la campagne 1 de 1987, entre les saumons roses et nerka au cours de toutes les campagnes effectuées au cours des deux années d'échantillonnage et entre les saumons kéta et nerka au cours de toutes les campagnes effectuées au cours des deux années. On a constaté une corrélation négative significative en ce qui a trait à la capture des saumons coho et nerka au cours de la campagne 1 de 1986. Les corrélations positives significatives ont été observées les deux années (sauf la corrélation entre le saumon rose et le saumon kéta au cours des campagnes 2 et 3 combinées de 1987), ce qui laisse entendre que les associations interspécifiques dans le détroit d'Hécate, surtout les corrélations positives, étaient relativement constantes au cours des deux années.

I. INTRODUCTION

This report analyzes juvenile salmon data collected during surveys in Hecate Strait in the summers of 1986 and 1987 (Morris and Healey 1987, 1988). The primary purpose of these surveys was to gather information on the abundance, species composition, size composition, and diet of juvenile salmon in Hecate Strait, for validation of a migration model designed by Healey (1986). The model predicts juvenile salmon abundance, size, and food resource requirements in Hecate Strait, based on assumptions about smolt production, growth rates, mortality rates, run timing, migration speed, and the migration route, for each species from six B.C. coastal regions. If the model is validated, it will assist in evaluating how Hecate Strait is used as a migration corridor and rearing area by juvenile salmon.

Juvenile salmon sex ratios, size composition, length-weight relationships, and interspecific correlations of size and catch rate among purse seine sets are all discussed in this report.

II. METHODS

The Biological Sciences Branch of the Department of Fisheries and Oceans chartered commercial drum seine boats (20 m in length) in 1986 and in 1987 to undertake the juvenile salmon surveys in Hecate Strait (Morris & Healey 1987, 1988). The chartered vessels were the F/V PACIFIC FAITH in 1986 and the A.L.H. in 1987. Scientific personnel from the Biological Sciences Branch accompanied the charter vessels to observe the seining and to carry out the data collection.

A commercial salmon purse seine, modified by the attachment of a fine mesh bunt, was used to capture juvenile salmon. In 1986, the seine net measured approximately 400 m long and 50 m deep, whereas in 1987, the commercial seine was 384 m long and 64 m deep. The small mesh bunt, used in both 1986 and 1987, measured 55 m long and 73 m deep, had a stretched mesh size of 1.27 cm, and was made of 210/20 knotless nylon. During each purse seine set, the net was towed in the half set position for 20 minutes with the aid of a powered skiff. Two sets were made at each sampling location, one with the net held open to the north, the other with the opening facing south.

The area surveyed covered the southern area of Hecate Strait, from the south end of Price Island (52°15'N) to the southern tip of Banks Island (53°20'N; Figure 1). The original sampling strategy was to make purse seine sets at predetermined distances along several transect lines that were at right angles to the coast. However, due to poor weather and sea conditions, sampling was occasionally restricted to more inshore locations or to the more protected waters of the channels between the islands. In 1986, the sampling west of the islands ranged from 3 to 32 km offshore, whereas the sampling in 1987 was from approximately 1 km to 24 km offshore.

In 1986, the fish sampling was conducted on 2 cruises, from July 7 to July 11 and from July 31 to August 2. There were 3 cruises in 1987, from July 3 to 7, August 13 to 14 and from August 19 to 20. A total of 50 sets were made in 1986, while 52 sets were made in 1987.

During the first cruise of 1986, fish were collected on two transects, one travelling west off the southern tip of Price Island, the other running southwest off of the southwest corner of Banks Island (Figure 2a). The second cruise of 1986 included one westward transect off the southern point of Price Island and one southwest transect off the south end of the Estevan Islands. Fish were also sampled at several sheltered locations in Caamano Sound, Laredo Channel and Seaforth Channel during this cruise.

Juvenile salmon were collected on four transects during the first cruise of 1987 (July 3-7; Figure 2b). These included westward transects off the south tip of Price Island, the south end of Aristazabal Island, the north end of Aristazabal Island, and a short transect approximately off the mid-point of the Estevan Island Group. Sets were also made during this cruise in Nepean Sound, Estevan Sound, Caamano Sound, and off the south end of Banks Island.

The last two cruises, in August, 1987, were orginally planned to be a single cruise, but this was split into two time periods to allow the fishermen to participate in a commercial fisheries opening, as agreed to in their charter contract. Cruise 2 (Aug. 13-14, 1987) included short west-running transects from the southern and northern ends of Aristazabal Island and sets in Laredo Channel. During the third cruise of 1987 (Aug. 19-20), a westward transect was made off the south end of Banks Island and two sets were made west of the approximate mid-point of the Estevan Island Group.

In 1986, the juvenile salmon samples were either frozen or preserved in 10% formalin. Preservation by freezing was unsatifactory; freezer shutdowns resulted in extensive deterioration of the samples, so they could not be used for sex determination. Therefore, the 1986 'sex' database was compiled only from formalin-preserved samples. All of the samples were preserved in formalin in 1987.

The data from the surveys were analyzed using the Statistical Analysis System of SAS Institute Inc.

III. RESULTS AND COMMENTS

The majority of juvenile salmon captured in the surveys (Morris and Healey 1987, 1988) were pink salmon (Onchorynchus gorbuscha), particularly in 1987 (2,901 in 1986, 13,150 in 1987). The next most abundant salmon was chum (O. keta; 741 in 1986, 1,553 in 1987), followed by coho (O. kisutch; 388 in 1986, 465 in 1987) and then sockeye (O. nerka; 191 in 1986, 446 in 1987). Only a few chinook salmon (O. tshawytscha) were caught (24 in 1986, 13 in 1987).

(A) MALE AND FEMALE PERCENT COMPOSITIONS

The percent composition of each sex was calculated for pink, chum, sockeye and coho in each cruise for each year (Table 1). Chi-square tests were performed to test whether male and female percentages differed significantly from 50%.

There were no significant differences between the percentages of males and females at the 0.05 level of significance. At the 0.10 level of significance, there were significantly fewer male chum (44.31%) than female chum (55.69%) for the combination of Cruise 1 and 2 in 1986 ($X^2 = 3.187$). In the same year, there were significantly more male sockeye (60.29%) than female sockeye (39.71%) in Cruise 1 only ($X^2 = 2.882$).

There were no significant differences between male and female percentages in 1987 for any species in any of the cruises (coho male and female percent compositions were not determined). However, it should be noted that the sample sizes for chum and sockeye in Cruise 1 and 2 were small.

(B) LENGTH AND WEIGHT DATA

(i) Length-weight Regressions

Length-weight regression analyses were performed to investigate differences between preservation methods (i.e. freezing versus formalin-preservation), between the sexes, between species within years, and between years within species. For the analyses, the data were transformed to the natural log of weight and the natural log of length. T-tests were performed on the slopes and the intercepts of the regression lines at the 0.05 level of significance.

(a) Preservation Method Comparisons: Freezing vs. Formalin: Since samples were preserved in 1986 by both freezing and formalin, tests were performed to determine whether there were any significant differences between the length-weight regressions of these two preservation methods. Results of the t-tests showed that formalin-preserved pink, chum, and coho salmon had significantly greater regression line slopes than frozen salmon of their respective species, at the 0.05 level of significance (Table 2a). There was no significant difference for sockeye salmon (Table 2a).

Note that male and female data were combined, and that this test could only be applied to 1986 data (all of the 1987 samples were preserved in formalin). Unless otherwise stated, formalin-preservation should be assumed in any further discussions. All frozen samples were analysed separately, due to this significant difference between preservation methods.

(b) Between Sex Comparisons: There were no significant differences between male and female length-weight regressions for pink, chum, sockeye or coho in either 1986 (formalin-preserved samples only) or 1987 (Table 2b).

(c) Between Species Comparisons within Years: When the length-weight regressions for 1986 frozen and formalin-preserved salmon were tested separately for significant differences between the species, the results were similiar for both preservation methods (Table 2a; Figures 3a-3b). Frozen pink salmon had a significantly greater regression line slope than all other frozen species, while the slope for formalin-preserved pink was signficantly greater than formalin-preserved sockeye and coho, but not significantly different than formalin-preserved chum. Whether frozen or formalin-preserved, chum had a significantly greater length-weight regression line slope than sockeye and coho. Length-weight regression lines for sockeye and coho were not significantly different with either preservation method.

The 1987 species comparisons (formalin-preserved only) produced different results (Table 2a; Figure 3c). The pink salmon had a length-weight regression line slope that was significantly greater than coho, significantly lower than chum salmon, but was not significantly different than sockeye. Chum salmon had a significantly greater slope than all other species. As in 1986, there was no significant difference between sockeye and coho length-weight regressions.

Although there were significant differences between the species length-weight regressions lines for the weight ranges observed, the absolute differences were small (Table 2a; Figure 3c).

(d) Between Year Comparisons by Species: The 1986 formalin-preserved pink, chum and coho had significantly greater length-weight regression line slopes than their respective species in 1987 (Table 2a). For each of these species, 1986 juvenile salmon had lower weights per fork length than 1987 fish when they were small, and higher weights per fork length when they were larger. There was no significant difference between 1986 and 1987 sockeye regression lines (Table 2a).

In 1986, all formalin-preserved salmon, except sockeye, had significantly greater length-weight regression line slopes than frozen samples of their respective species (Table 2a). There were no significant differences between male and female regression slopes of any species in 1986 and 1987 (Table 2b). In 1986, pink salmon had the greatest regression line slope of all frozen fish and of all formalin-preserved fish, except for chum, for which there was no significant difference. In 1987, chum salmon had the greatest slope, followed by pink salmon. Sockeye and coho had the smallest length-weight regression slopes in both 1986 and 1987, and were not significantly different with either preservation method. The 1986 pink, chum and coho had significantly greater slopes than their respective species in 1987, while there was no significant difference between 1986 and 1987 sockeye regression slopes.

(ii) Mean Fork Lengths

The mean fork length (mm), mean weight (g), the standard error of fork length and weight, and the sample size were calculated for each sex of each species and for both sexes combined, in each cruise of each year (Table 3). Note that fork length data were obtained from all fish, but only some fish were retained for sex determination (i.e. 2 databases were created; one database had fork lengths for all fish but no sex information, while the other smaller database included both fork lengths and sex information). Mean fork lengths for the combined sexes were calculated from whichever database had the largest fork length sample size for a particular species. Therefore, the mean length of males and females (separate or combined) may be quite different than the mean length obtained from the 'unsexed' fish.

Pink salmon ranged in length from 71 to 136 mm in Cruise 1, 1986 (mean of 98.64 mm) and increased to a range of 82 to 191 mm in Cruise 2, 1986 (mean of 135.22 mm; Figure 4a). Pink also increased in length from Cruise 1, 1987 (range of 60 to 193 mm; mean of 101.20 mm) to Cruise 2, 1987 (range of 98 to 190 mm; mean of 146.60 mm), but decreased in mean length from Cruise 2 to Cruise 3, 1987 (range of 104 to 206 mm; mean of 141.40 mm).

Chum salmon ranged in length from 69 to 145 mm in Cruise 1, 1986 (mean of 103.07 mm) and increased to a range of 82 to 200 mm in Cruise 2, 1986 (mean of 137.66 mm; Figure 4b). Similar to pink salmon, chum increased in length from Cruise 1, 1987 (range of 72 to 191 mm; mean of 111.90 mm) to Cruise 2, 1987 (range of 119 to 202 mm; mean of 170.00 mm), and decreased from Cruise 2 to Cruise 3, 1987 (range of 109 to 194 mm; mean of 147.18 mm). However, the sample sizes for chum in Cruise 2 and Cruise 3, 1987, were low (48 and 45, respectively).

Sockeye ranged in length from 85 to 175 mm in Cruise 1, 1986 (mean of 120.99 mm) and increased to a range of 102 to 197 mm in Cruise 2, 1986 (mean of 144.63 mm; Figure 4c). Sockeye increased in length from Cruise 1, 1987 (range of 79 to 155 mm; mean of 116.00 mm) to Cruise 2, 1987 (range of 129 to 211 mm; mean of 151.70 mm), and then, like pink and chum, decreased from Cruise 2 to Cruise 3, 1987 (range of 126 to 166 mm; mean of 149.30 mm).

Again, the sample sizes for sockeye salmon were low in Cruise 2 and 3 in 1987 (49 and 65, respectively).

Coho salmon ranged in length from 90 to 261 mm in Cruise 1, 1986 (mean of 165.67 mm), and increased to a range of 150 to 275 mm in Cruise 2, 1986 (mean of 219.13 mm; Figure 4d). Coho increased in length from Cruise 1, 1987 (range of 115 to 286 mm; mean of 185.29 mm) to Cruise 2, 1987 (range of 121 to 397 mm; mean of 237.90 mm) and increased again from Cruise 2 to Cruise 3, 1987 (range of 199 to 296 mm; mean of 251.10 mm). Note the small sample size of 16 for Cruise 3, 1987.

Very few chinook salmon were captured in 1986 or 1987 (24 and 13, respectively). Their fork lengths ranged from 138 to 297 mm in 1986 and from 180 to 350 mm in 1987.

Pink and chum salmon were relatively similar in fork length within each cruise. Sockeye were only slightly larger than the pink and chum, whereas coho had much larger fork lengths. The few chinook caught were also much larger than the pink, chum and sockeye, but were similar in size to coho in Cruise 1 in 1986 and 1987, and relatively smaller than coho in Cruise 2, 1986 and Cruises 2 and 3, 1987. Within each cruise in both years, there was a relatively broad range of sizes for each species. There was also a large overlap in size ranges between cruises within each year for each species.

(a) Influence of Cruise Timing and Sampling Distance Offshore on Mean Fork Lengths: Two-way ANOVA's at the 0.05 level of signifcance were used to test whether mean fork length varied among distances offshore and between cruises, and whether there was a cruise x distance offshore interaction (Tables 4a - 4h). There were 5 different categories of 'distance offshore' arbitrarily chosen in 1986 and in 1987. In 1986 they were: 'INSIDE CHANNELS' (including Caamano Sound, Laredo Channel and Seaforth Channel); '3-8' (3 to 8 km offshore); '9-16'; '17-24'; and, '>25' (more than 25 km offshore). The 5 'distances offshore' in 1987 were: 'INSIDE CHANNELS' (including Nepean Sound, Estevan Sound, Caamano Sound and Laredo Channel); 'BEACH' (approximately 1 km offshore); '3-8'; '9-16'; and, '17-24'. The mean lengths of each species in each set (calculated only from sets with a sample size >=5), within each year, and within each cruise, were used as the data, and all sets at each distance offshore were the replicates. Male and female data were combined for the analysis; 1986 frozen and formalin-preserved salmon data were also combined for the analysis.

As outlined previously, the mean fork lengths of each salmon species in 1986 were significantly greater in the second cruise than during the first cruise ($F>140$, $df=1$, $P<=0.0001$). In 1987, the second cruise had the significantly largest mean fork lengths, followed by the third and then the first cruise, with the exception of sockeye and coho, for which mean fork lengths were similar between Cruise 2 and 3. However, the cruise x distance offshore interaction was highly significant for pink salmon in 1986 and 1987, for chum in 1986, and for sockeye and coho in 1987. While the cruise timing had a highly significant effect on the mean fork length, the influence of distance offshore alone on the mean fork length of any of these samples is not easily interpreted.

The cruise x distance offshore interaction was not significant for 1987 chum (F=1.93, df=4, P>F=0.1031; Table 4d) and 1986 sockeye (F=2.49, df=2, P>F=0.0865; Table 4e), and was particularly low for 1986 coho (F=0.25, df=2, P>F=0.7805; Table 4g). However, the influence of cruise timing alone and the distance offshore alone were highly significant for each of these same fish. This indicates, firstly, that the mean fork lengths of the 1986 coho and 1986 sockeye were significantly greater during the second cruise than the first cruise, and that the mean fork length of the 1987 chum was greatest during the second cruise, followed by the third cruise, and then the first cruise. Secondly, in the case of the 1986 coho, the mean fork length was significantly larger the further sampling was performed away from shore and away from the inner channels (i.e. >25 > 9-16 = 17-24 > 3-8 > INSIDE CHANNELS; Figure 5). (Note that there was no sampling performed in the '17-24 km offshore' interval during Cruise 2, so a straight line was interpolated between the '9-16' and '>25' distance intervals in Figure 5). However, it is not clear how the distance offshore affected the mean fork length of the 1987 chum and 1986 sockeye (ie. there is no general relationship between mean fork length and the distance offshore).

The differences between mean fork lengths during the cruises in both years were quite large for all species. In 1986, the mean fork lengths for all species were significantly larger in the first cruise than in the second cruise. In 1987, the significantly largest mean fork lengths for all species occurred during the second cruise, followed by the third cruise and then the first cruise, except for sockeye and coho, for which there was no significant difference between the second and third cruise. Although mean fork lengths at the various distances offshore were significantly different, there was no general pattern of the sampling locations' influence on the mean fork lengths for any of the species except 1986 coho. The mean fork length increased for 1986 coho the further offshore they were collected. Cruise x distance offshore interactions were highly significant for pink salmon in 1986 and 1987, for chum in 1986, and for sockeye and coho in 1987. These differences in mean fork lengths can only be used as rough indicators of growth rates, as different populations are likely represented at different sampling times and locations.

(iii) Length Conversion Formulae

For the length measurements made in 1986, formulae were calculated to convert fork length to total length, fork length to postorbital-hypural length, and total length to postorbital-hypural length (Table 5). All length measurements were made in millimeters. Male and female data were combined.

(C) SIZE CORRELATIONS BETWEEN SPECIES WITHIN SETS

Correlation coefficients between fork lengths (mm) of pink, chum, sockeye and coho captured in the same set were calculated for each cruise

during each year (Table 6) to determine whether there was a size correlation between these species, within individual sets (i.e. were small fish of 'species A' caught with small fish of 'species B', and were large fish caught with large fish, etc.?). The data from Cruises 2 and 3 of 1987 were combined for this analysis because they were sampled very close in time (Aug. 13-14 and Aug. 19-20, respectively).

There were significant size correlations between pink and chum fork lengths in 1986 (Cruise 1: R^2=0.8537, P>|T|=0.0010, Figure 6a; Cruise 2: R^2=0.3884, P>|T|=0.0131, Figure 6b) and in 1987 (Cruise 1: R^2=0.6675, P>|T|=0.0001, Figure 6c; Cruise 2 & 3 combined: R^2=0.7237, P>|T|=0.0074, Figure 6d). Although the size ranges were similar for both pink and chum in each of the cruises, especially in 1986, there was a greater size correlation in Cruise 1 in 1986 and 1987 than in Cruise 2, 1986 and Cruise 2 & 3, 1987 (i.e. the slopes were closer to 1.0 in Cruise 1 of 1986 and 1987). Additionally, the correlations between pink and chum fork lengths were very similar between the years for each of the cruises. There were also significant correlations between chum and sockeye in Cruise 2 of 1986 (R^2=0.5489, P>|T|=0.0136), and between chum and coho in Cruise 1 of 1986 (R^2=0.5991, P>|T|=0.0242). Although there was a significant correlation between sockeye and coho fork lengths in Cruise 2 of 1986 (R^2=0.9952, P>|T|=0.0442), it was only based on three sample sets.

The majority (79%) of the size correlations were positive. There were significant size correlations between pink and chum in Cruise 1 and Cruise 2, 1986 and Cruise 1 and Cruise 2 & 3, 1987, between chum and sockeye in Cruise 2, 1986, chum and coho in Cruise 1, 1986 and between sockeye and coho in Cruise 2, 1986, and all of these were positive. In general, there was a high size correlation within the sets, regardless of the species.

(D) SPECIES ASSOCIATIONS

The catch of pink, chum, sockeye and coho were compared within each cruise in each year to determine whether some species tended to be captured together, while other species tended to be segregrated. Correlation coeffients are presented in Table 7.

There were highly significant, positive correlations between the capture of pink and the capture of chum salmon in both cruises in 1986 and in Cruise 1 of 1987 (1986, Cruise 1: R^2=0.9782, P>|T|=0.0001, Figure 7a; 1986, Cruise 2: R^2=0.7125, P>|T|=0.0001, Figure 7b; 1987, Cruise 1: R^2=0.8435, P>|T|=0.0001, Figure 7c). There were approximately 2.2 to 5.3 times as many pink caught per set as chum during these cruises (1986, Cruise 1: No. of pink = 2.19 [No. of chum] + 1.27; 1986, Cruise 2: No. of pink = 5.34 [No. of chum] + 18.34; 1987, Cruise 1: No. of pink = 5.31 [No. of chum] + 59.78; Table 7).

There were significant, positive correlations between the capture of pink and sockeye salmon during all cruises in both years. There were approximately 9.7 to 25 times as many pink per set as sockeye (1986, Cruise 1:

No. of pink = 11.71 [No. of sockeye] + 9.13; 1986, Cruise 2: No. of pink = 11.80 [No. of sockeye] + 19.87; 1987, Cruise 1: No. of pink = 9.74 [No. of sockeye] + 210.37; 1987, Cruise 2 & 3: No. of pink = 24.95 [No. of sockeye] + 36.02; Table 7).

There were also significant, positive correlations between the capture of chum salmon and the capture of sockeye in all cruises in both sampling years. There were approximately 2.2 to 5.4 times as many chum per set as sockeye in Cruise 1 in 1986 & 1987 (1986: No. of chum = 5.36 [No. of sockeye] + 3.53; 1987: No. of chum = 2.22 [No. of sockeye] + 24.07). However, there were approximately 1.7 times as many chum per set as sockeye during Cruise 2, 1986 (No. of chum = 1.71 [No. of sockeye] + 2.96; Table 7), whereas during Cruise 2 (&3), 1987, the opposite occurred - there were approximately 1.5 times as many sockeye as chum (i.e. No. of chum = 0.65 [No. of sockeye] + 0.95).

There was a significant, negative correlation between the capture of coho and sockeye during Cruise 1, 1986 (R^2=0.1835, T=-2.223, P>|T|=0.0368). During Cruise 1, 1986, there were few coho caught with relatively larger numbers of sockeye in sets off of Price Island (irrespective of the distance offshore), relatively large catches of coho with small numbers of sockeye in sets off of Banks Island, and large catches of coho with 0-1 sockeye per set in the inside channels. However, the correlations between coho and sockeye in 1987 were not significant (1987, Cruise 1: R^2=0.0000, T=-0.025, P>|T|=0.9800; Cruises 2 & 3 combined: R^2=0.0015, T=-0.169, P>|T|=0.8677; Table 7).

There were significant, positive correlations in 1986 and 1987 between pink and chum, pink and sockeye and between chum and sockeye, and a significant, negative correlation between coho and sockeye during Cruise 1, 1986. This suggests that interspecific associations within Hecate Strait, especially positive correlations, were relatively consistent each year.

IV. SUMMARY

The majority of juvenile salmon captured in the surveys (Morris and Healey 1987, 1988) were pink salmon (Onchorynchus gorbuscha), especially in 1987. The next most abundant salmon was chum (O. keta), followed by coho (O. kisutch), then sockeye (O. nerka), while only a few chinook salmon (O. tshawytscha) were caught.

There were no significant differences between male and female percentages of any species in either 1986 or 1987 at the 0.05 level of significance (Table 1). However, testing at the 0.10 level of significance showed there were more male sockeye than female sockeye during Cruise 1, 1986 and fewer male chum than female chum in Cruises 1 and 2, 1986 combined.

The 1986 formalin-preserved pink, chum and coho had significantly greater length-weight regression line slopes than the frozen salmon of their respective species, while there was no significant difference between the formalin-preserved and frozen sockeye slopes (Table 2a). There were no significant differences between male and female length-weight regression lines of any species in 1986 or 1987 (Table 2b). The 1986 frozen pink salmon had the significantly largest length-weight regression line slope of all 1986 frozen salmon, while the slopes of 1986 formalin-preserved pink and 1986 formalin-preserved chum were not significantly different (Table 2a). The 1986 sockeye and coho had the smallest regression line slopes for both preservation methods, and were not significantly different from each other. Chum salmon had the largest regression line slope of all other species in 1987. The 1987 pink salmon length-weight regression line slope was significantly greater than the slope for 1987 coho, but was not significantly different than the 1987 sockeye slope. There were no significant differences between the 1987 sockeye and coho length-weight regressions. The 1986 formalin-preserved pink, chum and coho had significantly greater length-weight regression line slopes than their respective species in 1987, while there was no significant difference between the 1986 and 1987 sockeye regressions (Table 2a).

For each species, there was a relatively broad range of sizes within each cruise in both years, and a large overlap in fork lengths between cruises within each year (Table 3; Figures 4a-4d). Pink and chum salmon were relatively similar in fork length within each cruise, while sockeye were only slightly larger, and coho were much larger.

In 1986, the mean fork lengths of all species were significantly larger in the first cruise than in the second cruise (Tables 4a, 4c, 4e, 4g). In 1987, the significantly largest mean fork lengths for all species occurred during the second cruise (Tables 4b, 4d, 4f, 4h). This was followed by the third cruise and then the first cruise, except for sockeye and coho, for which there were no significant differences in mean fork lengths between the second and third cruise. Mean fork lengths were significantly different between the various distances offshore. However, there was no general pattern of sampling location influence on the mean fork lengths for any of the species except 1986 coho, for which the mean fork length increased with the distance offshore (Figure 5). Cruise x distance offshore interactions were highly significant for pink salmon in 1986 and 1987, for chum in 1986, and for sockeye and coho in 1987. These differences in mean fork lengths can only be used as rough indicators of growth rates, as different populations are likely represented at different sampling times and locations.

Correlation coefficients were calculated for each cruise in each year to determine whether there was a size correlation between species within individual purse seine sets (Table 6). The majority of the size correlations were positive, and all of the significant correlations (25%) were positive. Significant size correlations existed between pink and chum in Cruise 1 and Cruise 2, 1986 and Cruise 1 and Cruise 2 & 3, 1987, between chum and sockeye in Cruise 2, 1986, chum and coho in Cruise 1, 1986 and between sockeye and coho in Cruise 2, 1986. In general, there was a high size correlation within the sets, regardless of the species (ie. small salmon of 'species A' were

caught with small salmon of 'species B', large salmon of 'species A' were caught with 'species B', etc.).

Correlation coefficients were also calculated for each cruise in each year to determine whether some species tend to be captured together, while other species tend to be segregated (Table 7). There was a highly significant, positive correlation between the capture of pink and the capture of chum salmon during Cruise 1 and 2, 1986 and during Cruise 1, 1987. The ratio of pink salmon to chum salmon caught per set ranged from approximately 2.2:1 to 7.9:1. There was a significant, positive correlation between the capture of pink salmon and the capture of sockeye in both sampling years. The ratio of pink to sockeye salmon caught per set ranged from approximately 9.7:1 to 25:1. There was also a significant, positive correlation between the capture of chum and sockeye salmon. There were from approximately 1.7 to 5.4 times as many chum as sockeye caught per set for all cruises except Cruise 2 & 3 combined, 1987, when there were approximately 1.5 times as many sockeye caught per set as chum. There was a significant, negative correlation between the capture of coho and sockeye during Cruise 1, 1986. There were few coho caught with relatively larger numbers of sockeye in sets off of Price Island (irrespective of the distance offshore), relatively large catches of coho with small numbers of sockeye in sets off of Banks Island, and large catches of coho with 0-1 sockeye per set in the inside channels. The significant correlations between pink and chum, pink and sockeye, and between chum and sockeye, were all positive, and occurred in both 1986 and 1987. This suggests that interspecific associations within Hecate Strait, especially positive correlations, were relatively consistent each year.

REFERENCES

Healey, M. C. 1986. Modeling juvenile salmon utilization of Hecate Strait, p. 17-19. In: A. V. Tyler [ed.]. Hecate Strait Project: Results of the first two years of multispecies fisheries research. Can. Tech. Rep. Fish. Aquat. Sci. 1470: 50 p.

Healey, M. C. and J. F. T. Morris. 1989. Catches of juvenile salmon and other pelagic fishes in Hecate Strait and comparison with predictions of a migration model, p. 46-53. In: A. V. Tyler [ed.]. Hecate Strait Project: Results from four years of multispecies fisheries research. Can. Tech. Rep. Fish. Aquat. Sci. 1675: 60 p.

Morris, J. F. T. and M. C. Healey. 1987. Hecate Strait juvenile salmon survey: July 6-12 and July 30 - August 3, 1986. Can. Data Rep. Fish. Aquat. Sci. 636: 65 p.

Morris, J. F. T. and M. C. Healey. 1988. Hecate Strait juvenile salmon survey: 1987. Can. Data Rep. Fish. Aquat. Sci. 701: 23 p.

Table 1. Total sample size (male and female) and percent composition of male pink, chum, sockeye and coho salmon in each cruise in 1986 and 1987. (* = significantly different male and female percentages at the 0.10 level of significance).

		PINK		CHUM		SOCKEYE		COHO	
YEAR	CRUISE	Total N	% Males	Total N	% Males	Total N	% Males	Total N	% Males
1986	1	287	50.52	139	44.60	68	60.29*	326	48.47
	2	539	48.79	107	43.93	116	45.69	163	52.15
	1 & 2	826	49.39	246	44.31*	184	51.09	489	49.69
1987	1	605	48.84	486	52.47	102	49.02	N/A	N/A
	2	250	52.00	48	43.75	20	40.00	N/A	N/A
	3	301	53.49	45	53.33	26	61.54	N/A	N/A
	1,2 & 3	1156	50.52	579	51.81	148	50.00	N/A	N/A

Table 2a. Regression equations for the natural log of weight on the natural log of fork length for 1986 frozen, 1986 formalin-preserved, and 1987 formalin-preserved pink, chum, sockeye and coho salmon. Note male and female data are combined. (WT = weight in grams; FL = fork length in millimeters).

1986 FROZEN:	SPECIES	REGRESSION EQUATION
	Pink	LN(WT) = 3.29 LN(FL) - 12.86
	Chum	LN(WT) = 3.23 LN(FL) - 12.54
	Sockeye	LN(WT) = 3.12 LN(FL) - 11.91
	Coho	LN(WT) = 3.10 LN(FL) - 11.83

1986 FORMALIN-PRESERVED:	SPECIES	REGRESSION EQUATION
	Pink	LN(WT) = 3.41 LN(FL) - 13.54
	Chum	LN(WT) = 3.38 LN(FL) - 13.38
	Sockeye	LN(WT) = 3.21 LN(FL) - 12.49
	Coho	LN(WT) = 3.26 LN(FL) - 12.70

1987 (FORMALIN-PRESERVED):	SPECIES	REGRESSION EQUATION
	Pink	LN(WT) = 3.12 LN(FL) - 12.16
	Chum	LN(WT) = 3.25 LN(FL) - 12.73
	Sockeye	LN(WT) = 3.05 LN(FL) - 11.78
	Coho	LN(WT) = 3.04 LN(FL) - 11.53

Table 2b. Regression equations for the natural log of weight on the natural log of fork length for each sex, for 1986 (formalin-preserved only) and 1987 pink, chum, sockeye and coho salmon. (WT = weight in grams; FL = fork length in millimeters).

SPECIES	YEAR	SEX	REGRESSION EQUATION
Pink	1986	Female	LN(WT) = 3.46 LN(FL) - 13.80
		Male	LN(WT) = 3.42 LN(FL) - 13.61
	1987	Female	LN(WT) = 3.15 LN(FL) - 12.28
		Male	LN(WT) = 3.14 LN(FL) - 12.24
Chum	1986	Female	LN(WT) = 3.36 LN(FL) - 13.30
		Male	LN(WT) = 3.37 LN(FL) - 13.36
	1987	Female	LN(WT) = 3.30 LN(FL) - 12.96
		Male	LN(WT) = 3.29 LN(FL) - 12.90
Sockeye	1986	Female	LN(WT) = 3.27 LN(FL) - 12.80
		Male	LN(WT) = 3.11 LN(FL) - 12.01
	1987	Female	LN(WT) = 3.10 LN(FL) - 11.98
		Male	LN(WT) = 3.15 LN(FL) - 12.22
Coho	1986	Female	LN(WT) = 3.32 LN(FL) - 13.07
		Male	LN(WT) = 3.30 LN(FL) - 12.96
	1987	Female	LN(WT) = 3.06 LN(FL) - 11.62
		Male	LN(WT) = 2.98 LN(FL) - 11.19

Table 3. The mean fork length (mm), mean weight (g), standard error (STD ERR) of fork length and weight, and the sample size, for male (M), female (F) and both sexes together (B), for pink, chum, sockeye, coho, and chinook salmon in each cruise in 1986 and 1987. Note that 2 separate databases are used (* indicates from database with no sex information). The 1986 data includes both frozen and formalin-preserved salmon. (1986 Cruise 1 = July 7-11, Cruise 2 = July 31 - Aug. 2; 1987 Cruise 1 = July 3-7, Cruise 2 = Aug. 13-14, Cruise 3 = Aug. 19-20).

				FORK LENGTH (mm)			WEIGHT (g)		
SPECIES	YEAR	CRUISE	SEX	MEAN	STD ERR	N	MEAN	STD ERR	N
PINK	1986	1	M	101.05	0.77	145	8.75	0.23	145
			F	100.86	0.90	142	8.67	0.27	142
			B*	98.64	0.29	1,072	9.39	0.11	917
		2	M	135.32	1.11	263	25.63	0.67	263
			F	136.70	1.00	276	25.99	0.59	276
			B*	135.22	0.37	1,827	27.47	0.26	1,581
	1987	1	M	102.62	0.80	293	10.69	0.27	293
			F	98.74	0.74	312	9.42	0.23	312
			B*	101.20	0.10	9,546	10.07	0.05	9,546
		2	M	144.49	1.53	130	30.93	1.00	130
			F	147.05	1.46	120	32.00	0.97	120
			B*	146.60	0.60	985	31.38	0.38	985
		3	M	144.55	1.25	161	29.82	0.83	161
			F	144.97	1.39	140	30.75	1.04	140
			B*	141.40	0.30	2,616	27.38	0.19	2,616
CHUM	1986	1	M	104.03	1.86	62	10.56	0.64	62
			F	105.61	1.49	77	10.86	0.53	77
			B*	103.07	0.62	475	11.69	0.26	425
		2	M	139.23	4.05	47	31.52	2.80	47
			F	137.80	3.37	60	29.83	2.30	60
			B*	137.66	1.49	266	32.21	1.07	258
	1987	1	M	108.82	1.15	255	13.71	0.52	255
			F	109.19	1.25	231	14.18	0.63	231
			B*	111.90	0.50	1,459	14.70	0.22	1,459
		2	M	166.90	3.80	21	54.05	3.89	21
			F	172.41	3.01	27	58.99	3.11	27
			B	170.00	2.38	48	56.83	2.44	48
		3	M	145.54	3.89	24	35.82	3.36	24
			F	149.05	4.03	21	38.66	3.91	21
			B	147.18	2.78	45	37.15	2.54	45

Table 3 (cont.'d):

				FORK LENGTH (mm)			WEIGHT (g)		
SPECIES	YEAR	CRUISE	SEX	MEAN	STD ERR	N	MEAN	STD ERR	N
SOCKEYE	1986	1	M	121.95	2.98	41	21.06	1.43	41
			F	121.89	3.33	27	20.04	1.55	27
			B*	120.99	2.05	73	20.48	1.02	73
		2	M	147.38	3.20	53	41.21	2.76	53
			F	143.17	2.45	63	35.43	1.78	63
			B*	144.63	1.99	118	37.89	1.61	118
	1987	1	M	112.88	2.06	50	14.96	0.94	50
			F	115.69	2.09	52	15.90	0.83	52
			B*	116.0	0.90	332	16.04	0.35	332
		2	M	145.00	2.42	8	33.36	1.32	8
			F	147.58	2.72	12	33.91	1.97	12
			B*	151.70	1.90	49	36.32	1.61	49
		3	M	151.56	2.02	16	35.51	1.44	16
			F	148.50	1.75	10	34.44	1.18	10
			B*	149.30	1.20	65	33.97	0.77	65
COHO	1986	1	M	162.61	2.77	158	57.52	3.07	156
			F	168.57	2.38	167	61.63	2.64	167
			B	165.67	1.82	325	59.65	2.01	323
		2	M	222.67	1.83	85	147.21	3.97	85
			F	215.27	2.49	78	132.64	4.20	78
			B	219.13	1.55	163	140.24	2.93	163
	1987	1	M	184.73	1.55	212	82.29	2.24	212
			F	186.13	1.83	144	84.55	2.87	144
			B	185.29	1.18	356	83.20	1.77	356
		2	M	241.51	9.06	35	200.99	27.51	35
			F	229.79	5.95	19	157.42	12.43	19
			B*	237.90	4.80	82	180.51	13.52	82
		3	M	246.17	11.63	6	177.75	27.73	6
			F	288.50	1.50	2	279.05	4.75	2
			B*	251.10	7.00	16	192.91	15.61	16

Table 3 (cont.'d):

				FORK LENGTH (mm)			WEIGHT (g)		
SPECIES	YEAR	CRUISE	SEX	MEAN	STD ERR	N	MEAN	STD ERR	N
CHINOOK	1986	1	M	204.86	17.03	7	112.23	26.22	7
			F	220.88	17.98	8	145.86	36.33	7
			B	213.40	12.20	15	129.04	22.02	14
		2	M	224.57	10.31	7	159.19	24.32	7
			F	219.00	8.69	4	146.53	22.88	4
			B	222.55	7.04	11	154.58	16.93	11
	1987	1	M	231.00	17.04	3	174.23	36.85	3
			F	280.00	.	1	280.30	.	1
			B	243.25	17.18	4	200.75	37.18	4
		2	M	218.75	7.79	4	135.85	12.26	4
			F	184.00	.	1	69.20	.	1
			B	211.80	9.21	5	122.52	16.37	5
		3	M	.	.	0	.	.	0
			F	.	.	0	.	.	0
			B*	320.00	30.00	2	376.95	70.85	2

Table 4a. Mean fork lengths (FL, in mm) of 1986 pink salmon (with sample size N) for each distance offshore during each cruise, and table of analysis of variance below. (Note calculated from sets with sample sizes >= 5 only; Cruise 1 = July 7-11, Cruise 2 = July 31 - Aug. 2; P>F = the significance probability value associated with the F value).

CRUISE		DISTANCE OFFSHORE					
		INSIDE CHANNELS	3-8	9-16	17-24	>25	ALL DISTANCES
1	FL	97.5	100.1	99.0	96.4	113.2	98.7
	N	(35)	(301)	(355)	(341)	(25)	(1,057)
2	FL		125.0	138.1	146.4	135.8	135.2
	N		(333)	(158)	(203)	(1,128)	(1,822)
1 & 2	FL	97.5	113.2	111.0	115.1	135.3	121.8
	N	(35)	(634)	(513)	(544)	(1,153)	(2,879)

ANALYSIS OF VARIANCE TABLE

Source	df	Mean Square	F	P>F
Cruise	1	890,293.28	6,078.40	0.0
Distance	4	4,966.63	33.91	0.0001
Cruise x Distance	3	16,719.57	114.15	0.0
Error	2,845	146.47		

Table 4b. Mean fork lengths (FL, in mm) of 1987 pink salmon (with sample size N) for each distance offshore during each cruise, and table of analysis of variance below. (Note calculated from sets with sample sizes >= 5 only; Cruise 1 = July 3-7, Cruise 2 = Aug. 13-14, Cruise 3 = Aug. 19-20; P>F = the significance probability value associated with the F value).

CRUISE		DISTANCE OFFSHORE					
		INSIDE CHANNELS	BEACH	3-8	9-16	17-24	ALL DISTANCES
1	FL	92.8	87.7	96.1	105.8	106.0	101.2
	N	(358)	(1,044)	(2,129)	(2,499)	(3,505)	(9,535)
2	FL	134.8	140.3	152.3	156.1		146.6
	N	(48)	(453)	(315)	(169)		(985)
3	FL			142.9	139.8	139.7	141.4
	N			(1,361)	(383)	(872)	(2,616)
1,2 & 3	FL	97.8	103.6	117.5	112.8	112.7	112.6
	N	(406)	(1,497)	(3,805)	(3,051)	(4,377)	(13,136)

ANALYSIS OF VARIANCE TABLE

Source	df	Mean Square	F	P>F
Cruise	2	22,675.57	14,212.86	0.0
Distance	4	948.27	594.37	0.0
Cruise x Distance	5	165.62	103.81	0.0
Error	13,092	1.60		

Table 4c. Mean fork lengths (FL, in mm) of 1986 chum salmon (with sample size N) for each distance offshore during each cruise, and table of analysis of variance below. (Note calculated from sets with sample sizes >= 5 only; Cruise 1 = July 7-11, Cruise 2 = July 31 - Aug. 2; P>F = the significance probability value associated with the F value).

CRUISE		DISTANCE OFFSHORE					
		INSIDE CHANNELS	3-8	9-16	17-24	>25	ALL DISTANCES
1	FL	89.2	109.2	102.4	99.4	117.9	103.2
	N	(18)	(130)	(135)	(169)	(16)	(468)
2	FL		119.6	137.9	141.4	147.2	137.2
	N		(83)	(18)	(18)	(136)	(255)
1 & 2	FL	89.2	113.3	106.6	103.4	144.1	115.2
	N	(18)	(213)	(153)	(187)	(152)	(723)

ANALYSIS OF VARIANCE TABLE

Source	df	Mean Square	F	P>F
Cruise	1	190,174.81	862.98	0.0
Distance	4	9,230.40	41.89	0.0001
Cruise x Distance	3	5,676.41	25.76	0.0001
Error	694	220.37		

Table 4d. Mean fork lengths (FL, in mm) of 1987 chum salmon (with sample size N) for each distance offshore during each cruise, and table of analysis of variance below. (Note calculated from sets with sample sizes >= 5 only; Cruise 1 = July 3-7, Cruise 2 = Aug. 13-14, Cruise 3 = Aug. 19-20; P>F = the significance probability value associated with the F value).

CRUISE		DISTANCE OFFSHORE					
		INSIDE CHANNELS	BEACH	3-8	9-16	17-24	ALL DISTANCES
1	FL	90.6	93.6	104.4	116.5	115.9	111.9
	N	(27)	(132)	(205)	(374)	(715)	(1,453)
2	FL	167.8		178.7	177.5		176.7
	N	(5)		(11)	(28)		(44)
3	FL			141.0	155.4	150.8	150.1
	N			(7)	(9)	(23)	(39)
1,2 & 3	FL	102.7	93.6	109.2	121.5	117.0	114.8
	N	(32)	(132)	(223)	(411)	(738)	(1,536)

ANALYSIS OF VARIANCE TABLE

Source	df	Mean Square	F	P>F
Cruise	2	1,146.30	438.72	0.0
Distance	4	216.70	82.94	0.0
Cruise x Distance	4	5.04	1.93	0.1031
Error	1,506	2.61		

Table 4e. Mean fork lengths (FL, in mm) of 1986 sockeye salmon (with sample size N) for each distance offshore during each cruise, and table of analysis of variance below. (Note calculated from sets with sample sizes >= 5 only; Cruise 1 = July 7-11, Cruise 2 = July 31 - Aug. 2; P>F = the significance probability value associated with the F value).

CRUISE		DISTANCE OFFSHORE					
		INSIDE CHANNELS	3-8	9-16	17-24	>25	ALL DISTANCES
1	FL		115.7	108.3	126.1	133.4	119.9
	N		(15)	(19)	(11)	(16)	(61)
2	FL		141.1	114.7		151.3	147.6
	N		(15)	(6)		(81)	(102)
1 & 2	FL		128.4	109.8	126.1	148.3	137.2
	N		(30)	(25)	(11)	(97)	(163)

ANALYSIS OF VARIANCE TABLE

Source	df	Mean Square	F	P>F
Cruise	1	29,246.56	141.38	0.0001
Distance	3	4,455.84	21.54	0.0001
Cruise x Distance	2	514.99	2.49	0.0865
Error	146	206.87		

Table 4f. Mean fork lengths (FL, in mm) of 1987 sockeye salmon (with sample size N) for each distance offshore during each cruise, and table of analysis of variance below. (Note calculated from sets with sample sizes >= 5 only; Cruise 1 = July 3-7, Cruise 2 = Aug. 13-14, Cruise 3 = Aug. 19-20; P>F = the significance probability value associated with the F value).

CRUISE		DISTANCE OFFSHORE					
		INSIDE CHANNELS	BEACH	3-8	9-16	17-24	ALL DISTANCE
1	FL			108.6	114.3	118.8	116.9
	N			(25)	(71)	(211)	(307)
2	FL		158.7	149.2	150.2		151.5
	N		(9)	(19)	(15)		(43)
3	FL			151.3	149.6	147.4	149.5
	N			(28)	(10)	(24)	(62)
1,2 & 3	FL		158.7	135.9	123.6	121.7	125.4
	N		(9)	(72)	(96)	(235)	(412)

ANALYSIS OF VARIANCE TABLE

Source	df	Mean Square	F	P>F
Cruise	2	436.55	240.68	0.0
Distance	3	7.14	3.94	0.0087
Cruise x Distance	3	5.41	2.98	0.0312
Error	394	1.81		

Table 4g. Mean fork lengths (FL, in mm) of 1986 coho salmon (with sample size N) for each distance offshore during each cruise, and table of analysis of variance below. (Note calculated from sets with sample sizes >= 5 only; Cruise 1 = July 7-11, Cruise 2 = July 31 - Aug. 2; P>F = the significance probability value associated with the F value).

CRUISE		DISTANCE OFFSHORE					
		INSIDE CHANNELS	3-8	9-16	17-24	>25	ALL DISTANCES
1	FL	142.4	168.1	188.3	200.5	198.4	165.9
	N	(126)	(34)	(33)	(31)	(33)	(257)
2	FL		199.6	217.4		224.4	221.0
	N		(5)	(31)		(64)	(100)
1 & 2	FL	142.4	172.1	202.4	200.5	215.5	181.3
	N	(126)	(39)	(64)	(31)	(97)	(357)

ANALYSIS OF VARIANCE TABLE

Source	df	Mean Square	F	P>F
Cruise	1	218,471.05	680.36	0.0
Distance	4	40,374.67	125.73	0.0
Cruise x Distance	2	79.65	0.25	0.7805
Error	335	321.11		

Table 4h. Mean fork lengths (FL, in mm) of 1987 coho salmon (with sample size N) for each distance offshore during each cruise, and table of analysis of variance below. (Note calculated from sets with sample sizes >= 5 only; Cruise 1 = July 3-7, Cruise 2 = Aug. 13-14, Cruise 3 = Aug. 19-20; P>F = the significance probability value associated with the F value).

CRUISE		DISTANCE OFFSHORE					
		INSIDE CHANNELS	BEACH	3-8	9-16	17-24	ALL DISTANCES
1	FL	164.2	189.1	189.0	191.4	186.3	187.7
	N	(24)	(50)	(75)	(132)	(67)	(348)
2	FL	241.7	218.6	236.4	219.6		235.8
	N	(24)	(5)	(39)	(5)		(73)
3	FL			252.5			252.5
	N			(14)			(14)
1,2 & 3	FL	202.9	191.8	210.4	192.4	186.3	197.8
	N	(48)	(55)	(128)	(137)	(67)	(435)

ANALYSIS OF VARIANCE TABLE

Source	df	Mean Square	F	P>F
Cruise	2	913.78	133.27	0.0
Distance	4	14.24	2.08	0.0830
Cruise x Distance	3	44.60	6.51	0.0003
Error	411	6.86		

Table 5. Formulae for fork length (FL) to total length (TL), fork length to postorbital-hypural length (PH), and total length to postorbital-hypural length conversions, for 1986 data only. (Note all length measurements are made in millimeters; male and female data are combined).

SPECIES	PRESERVATION	CONVERSIONS	FORMULAE
PINK	Frozen	FL TO TL	TL = 1.09 (FL) - 2.15
	(N=19)	FL TO PH	PH = 0.82 (FL) + 1.52
		TL TO PH	PH = 0.75 (TL) + 3.91
	Formalin	FL TO TL	TL = 1.09 (FL) - 1.48
	(N=348)	FL TO PH	PH = 0.81 (FL) + 3.46
		TL TO PH	PH = 0.75 (TL) + 2.96
CHUM	Frozen	FL TO TL	TL = 1.09 (FL) - 1.88
	(N=17)	FL TO PH	PH = 0.82 (FL) + 2.97
		TL TO PH	PH = 0.75 (TL) + 4.75
	Formalin	FL TO TL	TL = 1.09 (FL) - 1.60
	(N=114)	FL TO PH	PH = 0.82 (FL) + 1.66
		TL TO PH	PH = 0.75 (TL) + 2.96
	Frozen &	FL TO TL	TL = 1.09 (FL) - 1.52
	Formalin	FL TO PH	PH = 0.82 (FL) - 1.49
	(N=132)	TL TO PH	PH = 0.75 (TL) + 2.75
SOCKEYE	Frozen	FL TO TL	TL = 1.20 (FL) - 13.09
	(N=7)	FL TO PH	PH = 0.80 (FL) + 2.84
		TL TO PH	PH = 0.66 (FL) + 12.03
	Formalin	FL TO TL	TL = 1.08 (FL) + 0.59
	(N=54)	FL TO PH	PH = 0.83 (FL) - 0.92
		TL TO PH	PH = 0.76 (FL) - 1.14
COHO	Frozen	FL TO TL	TL = 1.06 (FL) + 6.50
	(N=4)	FL TO PH	PH = 0.88 (FL) - 16.06
		TL TO PH	PH = 0.81 (TL) - 14.78
	Formalin	FL TO TL	TL = 1.03 (FL) + 8.60
	(N=124)	FL TO PH	PH = 0.80 (FL) + 1.19
		TL TO PH	PH = 0.75 (TL) + 0.68

Table 6. Species comparisons of mean fork length/set (No./set >=5). (COMP = number of comparisons; PK = Pink; CM = Chum; SO = Sockeye; CO = Coho; fork length measured in millimeters; R^2 = the fraction of the total variation due to the variables in the model; T = t-value for testing the null hypothesis that the slope equals zero; P>|T| = the probability that the t-value could occur if the null hypothesis was true).

SPECIES	CRUISE	EQUATION	COMP	R^2	T	P>|T|
1986						
Pink vs. Chum	1	PK = 0.70(CM) + 27.88	12	0.8537	7.639	0.0010
	2	PK = 0.49(CM) + 66.57	15	0.3884	2.873	0.0131
Pink vs. Sockeye	1	PK = 0.41(SO) + 56.45	7	0.2081	1.146	0.3036
	2	PK = 0.10(SO) + 119.05	10	0.0564	0.691	0.5090
Pink vs. Coho	1	PK = 0.15(CO) + 69.93	10	0.3404	2.032	0.0766
	2	PK = -0.19(CO) + 170.74	5	0.0651	-0.457	0.6787
Chum vs. Sockeye	1	CM = 0.69(SO) + 28.08	7	0.3813	1.755	0.1396
	2	CM = 0.52(SO) + 66.89	9	0.5489	3.276	0.0136
Chum vs. Coho	1	CM = 0.35(CO) + 35.55	8	0.5991	2.995	0.0242
	2	CM = 0.70(CO) + 11.67	4	0.2986	0.923	0.4535
Coho vs. Sockeye	1	CO = -0.46(SO) + 258.34	3	0.0085	-0.093	0.9411
	2	CO = 2.88(SO) - 244.94	3	0.9952	14.371	0.0442
1987						
Pink vs. Chum	1	PK = 0.70(CM) + 24.08	21	0.6675	6.176	0.0001
	2 & 3	PK = 0.43(CM) + 74.52	8	0.7237	3.964	0.0074
Pink vs. Sockeye	1	PK = 0.52(SO) + 44.60	8	0.3688	1.872	0.1103
	2 & 3	PK = 0.38(SO) + 88.44	10	0.0571	0.696	0.5060
Pink vs. Coho	1	PK = 0.36(CO) + 29.74	13	0.1809	1.558	0.1474
	2 & 3	PK = 0.002(CO) + 147.27	8	0.0000	0.008	0.9940
Chum vs. Sockeye	1	CM = 0.56(SO) + 49.50	8	0.2624	1.461	0.1943
	2 & 3	CM = 1.54(SO) - 69.88	6	0.1248	0.755	0.4921
Chum vs. Coho	1	CM = 0.39(CO) + 35.02	12	0.1970	1.566	0.1484
	2 & 3	CM = -0.42(CO) + 270.37	3	0.9561	-4.666	0.1344
Coho vs. Sockeye	1	CO = -0.39(SO) + 233.95	5	0.2662	-1.043	0.3735
	2 & 3	CO = -0.72(SO) + 355.68	4	0.0650	-0.373	0.7450

Table 7. Species comparisons of catch/set. (COMP = number of comparisons; PK = Pink; CM = Chum; SO = Sockeye; CO = Coho; R^2 = the fraction of the total variation due to the variables in the model; T = the t-value for testing the null hypothesis that the slope equals zero; P>|T| = the probability that the t-value could occur if the null hypothesis was true).

1986

SPECIES	CRUISE	EQUATION	COMP	R^2	T	P>|T|
Pink vs. Chum	1	PK = 2.19(CM) + 1.27	24	0.9782	31.393	0.0001
	2	PK = 5.34(CM) + 18.34	22	0.7125	7.041	0.0001
Pink vs. Sockeye	1	PK = 11.71(SO) + 9.13	24	0.3964	3.801	0.0010
	2	PK = 11.80(SO) + 19.87	22	0.5723	5.174	0.0001
Pink vs. Coho	1	PK = -1.52(CO) + 61.90	24	0.0553	-1.135	0.2686
	2	PK = -1.54(CO) + 91.36	22	0.0252	-0.719	0.4808
Chum vs. Sockeye	1	CM = 5.36(SO) + 3.53	24	0.4080	3.894	0.0008
	2	CM = 1.71(SO) + 2.96	22	0.4820	4.314	0.0003
Chum vs. Coho	1	CM = -0.70(CO) + 27.76	24	0.0581	-1.165	0.2567
	2	CM = -0.34(CO) + 13.93	22	0.0486	-1.011	0.3243
Coho vs. Sockeye	1	CO = -1.23(SO) + 15.05	24	0.1835	-2.223	0.0368
	2	CO = -0.34(SO) + 7.14	22	0.0446	-0.966	0.3456

1987

Pink vs. Chum	1	PK = 5.31(CM) + 59.78	30	0.8435	12.285	0.0001
	2 & 3	PK = 7.88(CM) + 136.30	21	0.0484	0.983	0.3378
Pink vs. Sockeye	1	PK = 9.74(SO) + 210.37	30	0.4062	4.376	0.0001
	2 & 3	PK = 24.95(SO) + 36.02	21	0.3376	3.112	0.0057
Pink vs. Coho	1	PK = 6.65(CO) + 237.12	30	0.0959	1.723	0.0959
	2 & 3	PK = -9.17(CO) + 214.28	21	0.0588	-1.090	0.2894
Chum vs. Sockeye	1	CM = 2.22(SO) + 24.07	30	0.7056	8.192	0.0001
	2 & 3	CM = 0.65(SO) + 0.95	21	0.2912	2.794	0.0116
Chum vs. Coho	1	CM = 0.78(CO) + 39.12	30	0.0442	1.138	0.2649
	2 & 3	CM = 0.04(CO) + 4.28	21	0.0015	0.169	0.8674
Coho vs. Sockeye	1	CO = -0.00(SO) + 12.24	30	0.0000	-0.025	0.9800
	2 & 3	CO = -0.04(SO) + 4.91	21	0.0015	-0.169	0.8677

Fig. 1. The study area location within Hecate Strait.

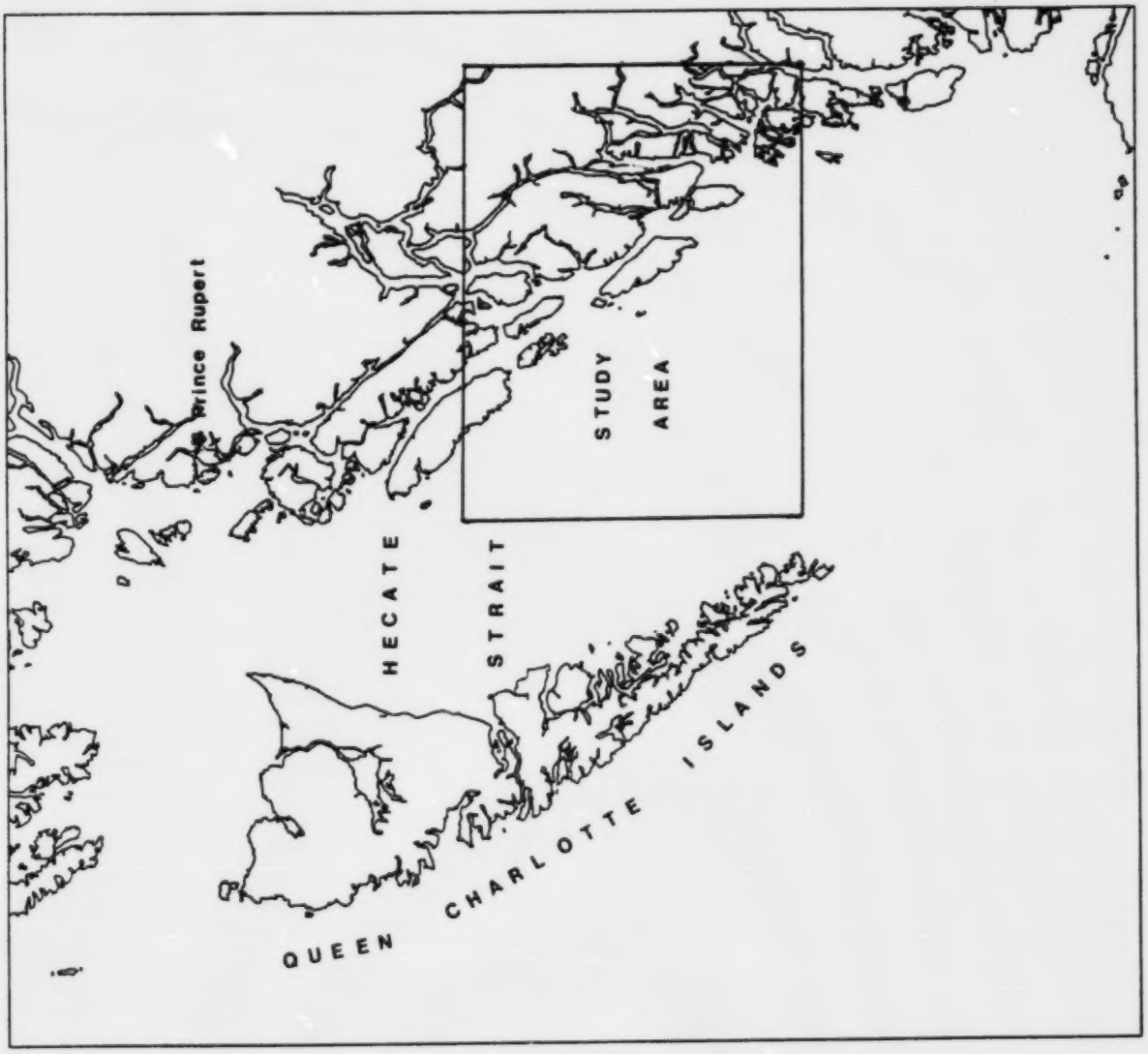

Prince Rupert
STUDY AREA
HECATE STRAIT
QUEEN CHARLOTTE ISLANDS

Fig. 2a. The study area, indicating the 1986 purse seine set locations for each cruise and for the 5 'distance intervals'.

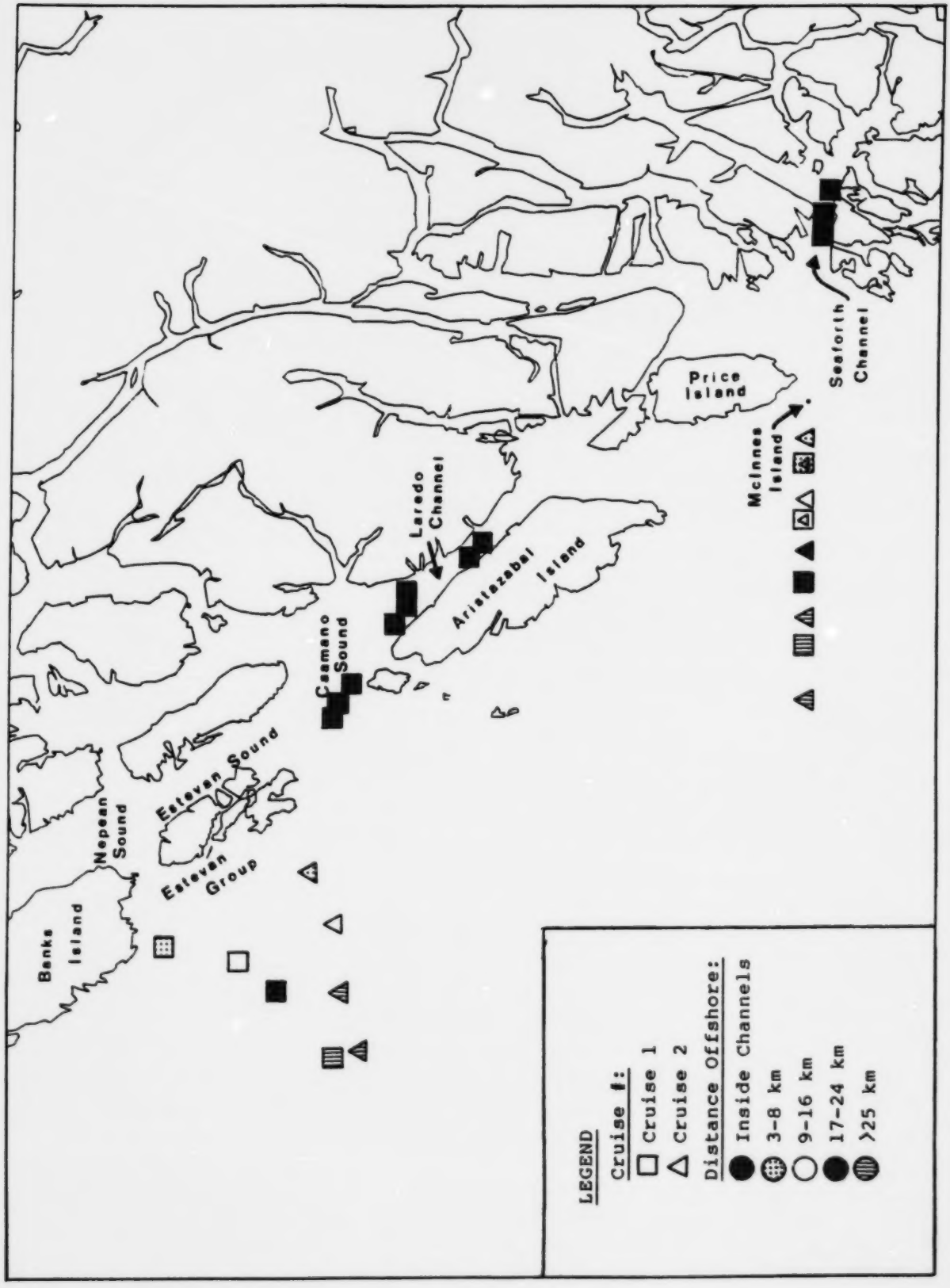

Banks Island
Nepean Sound
Esteven Sound
Esteven Group
Cascano Sound
Laredo Channel
Arisiazabal Island
Price Island
McInnes Island
Seaforth Channel
LEGEND
Cruise #:
Cruise 1
Cruise 2
Distance Offshore:
Inside Channels
3-8 km
9-16 km
17-24 km
>25 km

Fig. 2b. The study area, indicating the 1987 purse seine set locations for each cruise and for the 5 'distance intervals'.

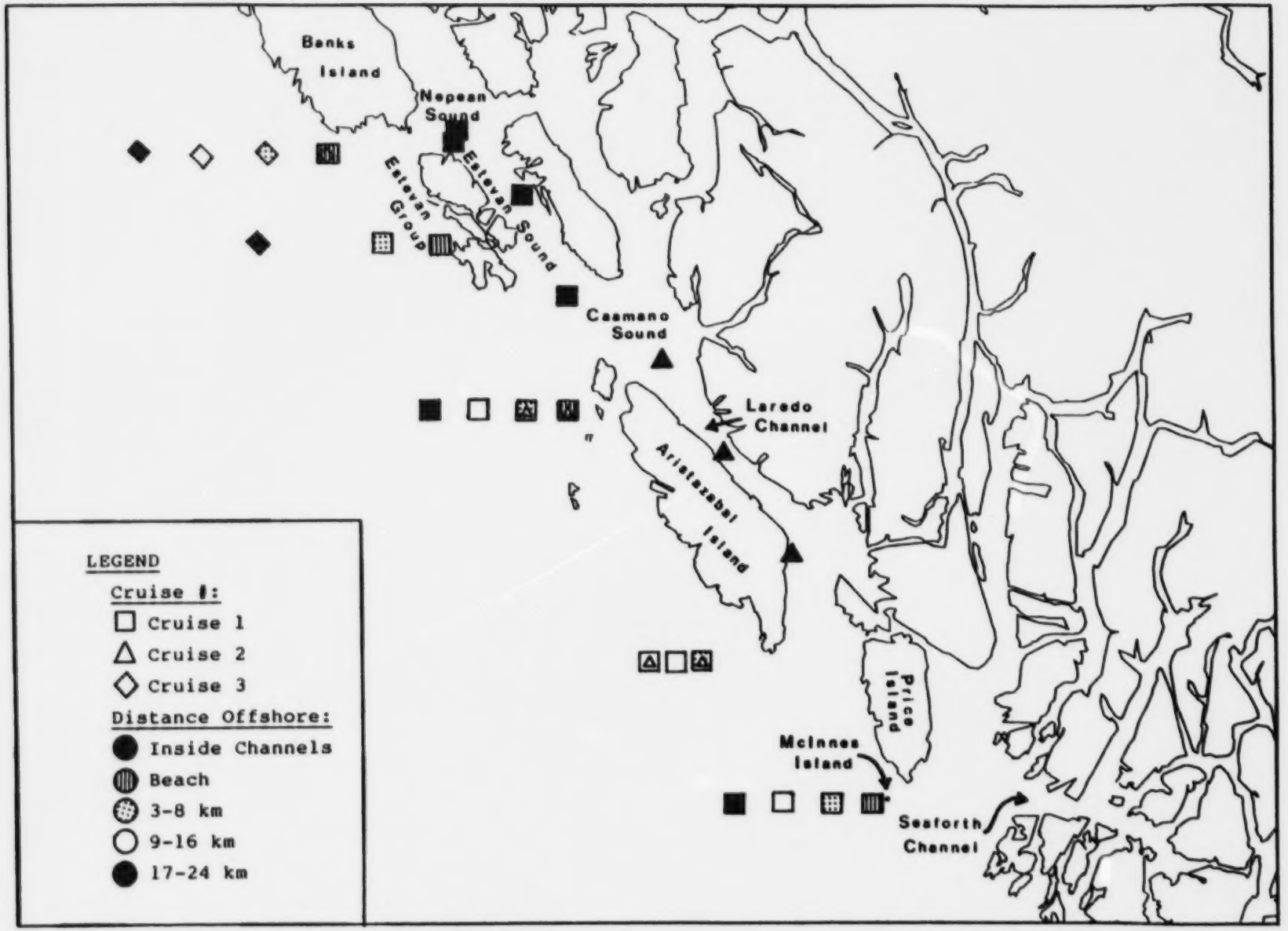

Banks Island
Nepean Sound
Estevan Group
Estevan Sound
Caamano Sound
Laredo Channel
Aristazabal Island
Price Island
McInnes Island
Seaforth Channel
LEGEND
Cruise #:
Cruise 1
Cruise 2
Cruise 3
Distance Offshore:
Inside Channels
Beach
3-8 km
9-16 km
17-24 km

Fig. 3a. Regressions of the natural log of weight (g) on the natural log of fork length (mm) of 1986 frozen juvenile pink, chum, sockeye and coho salmon.

1986 FROZEN JUVENILE SALMON LENGTH – WEIGHT REGRESSIONS

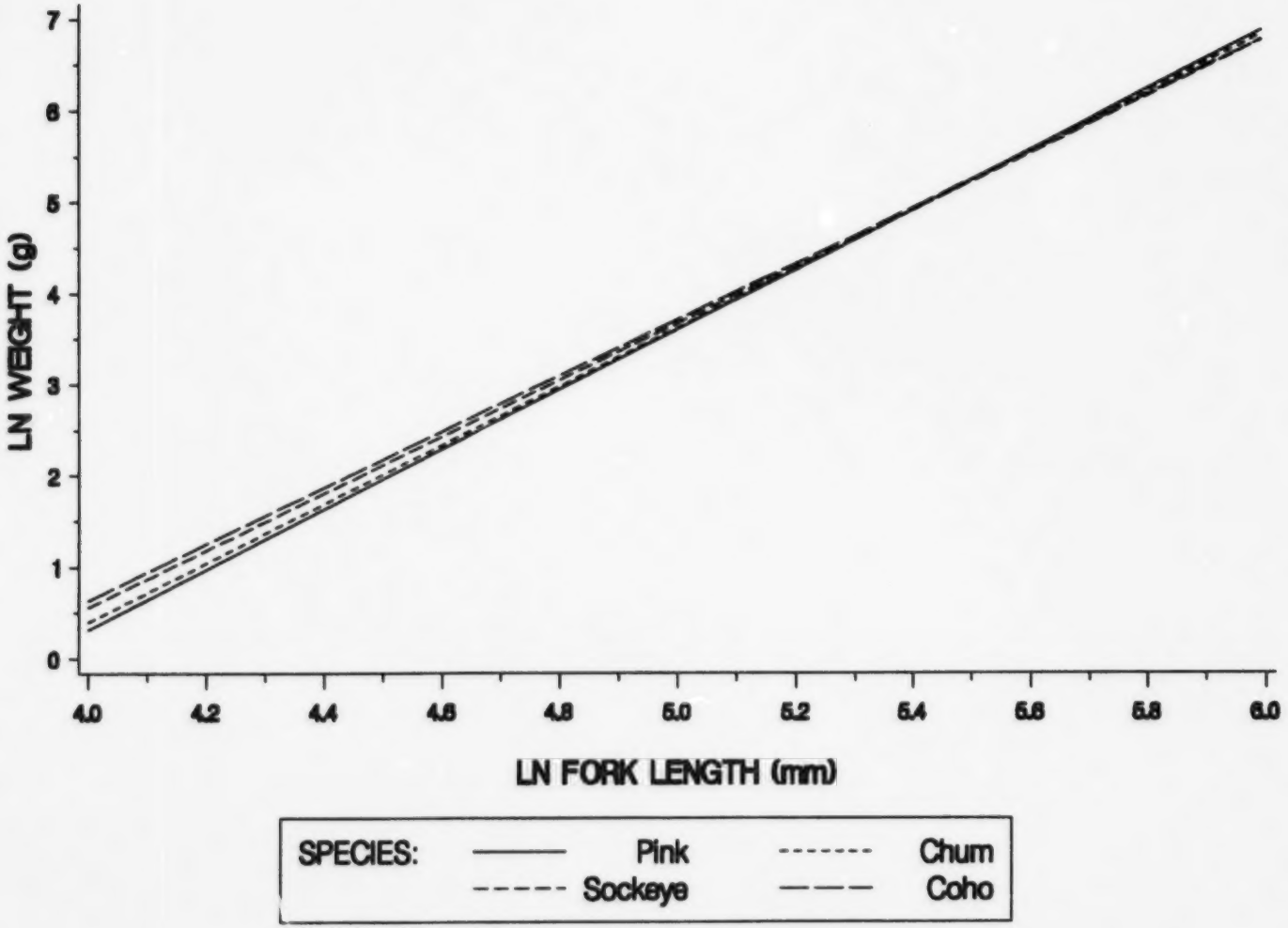


Fig. 3b. Regressions of the natural log of weight (g) on the natural log of fork length (mm) of 1986 formalin-preserved juvenile pink, chum, sockeye and coho salmon.

1986 FORMALIN – PRESERVED JUVENILE SALMON LENGTH – WEIGHT REGRESSIONS

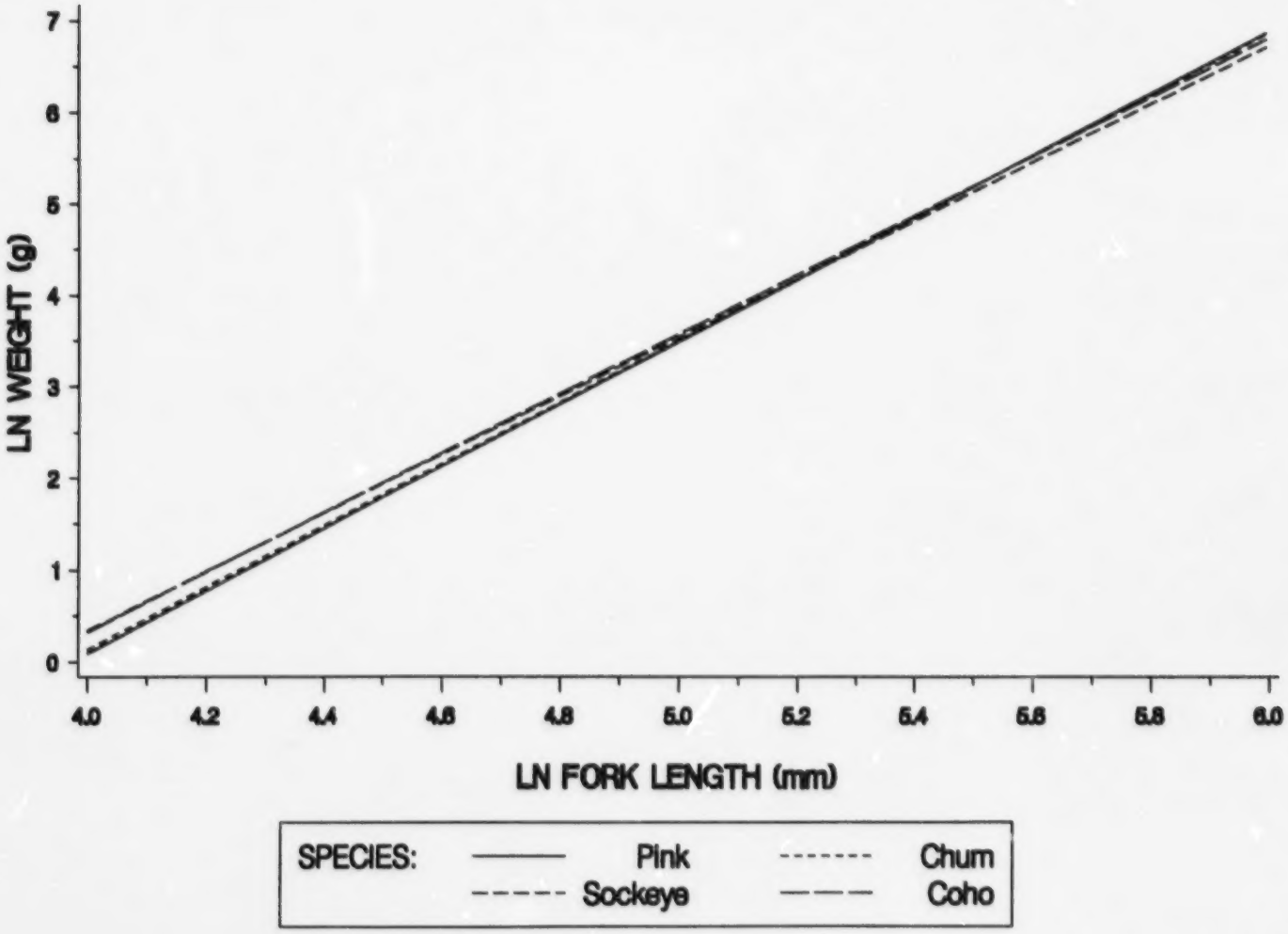


Fig. 3c. Regressions of the natural log of weight (g) on the natural log of fork length (mm) of 1987 (formalin-preserved) juvenile pink, chum, sockeye and coho salmon.

1987 JUVENILE SALMON LENGTH – WEIGHT REGRESSIONS

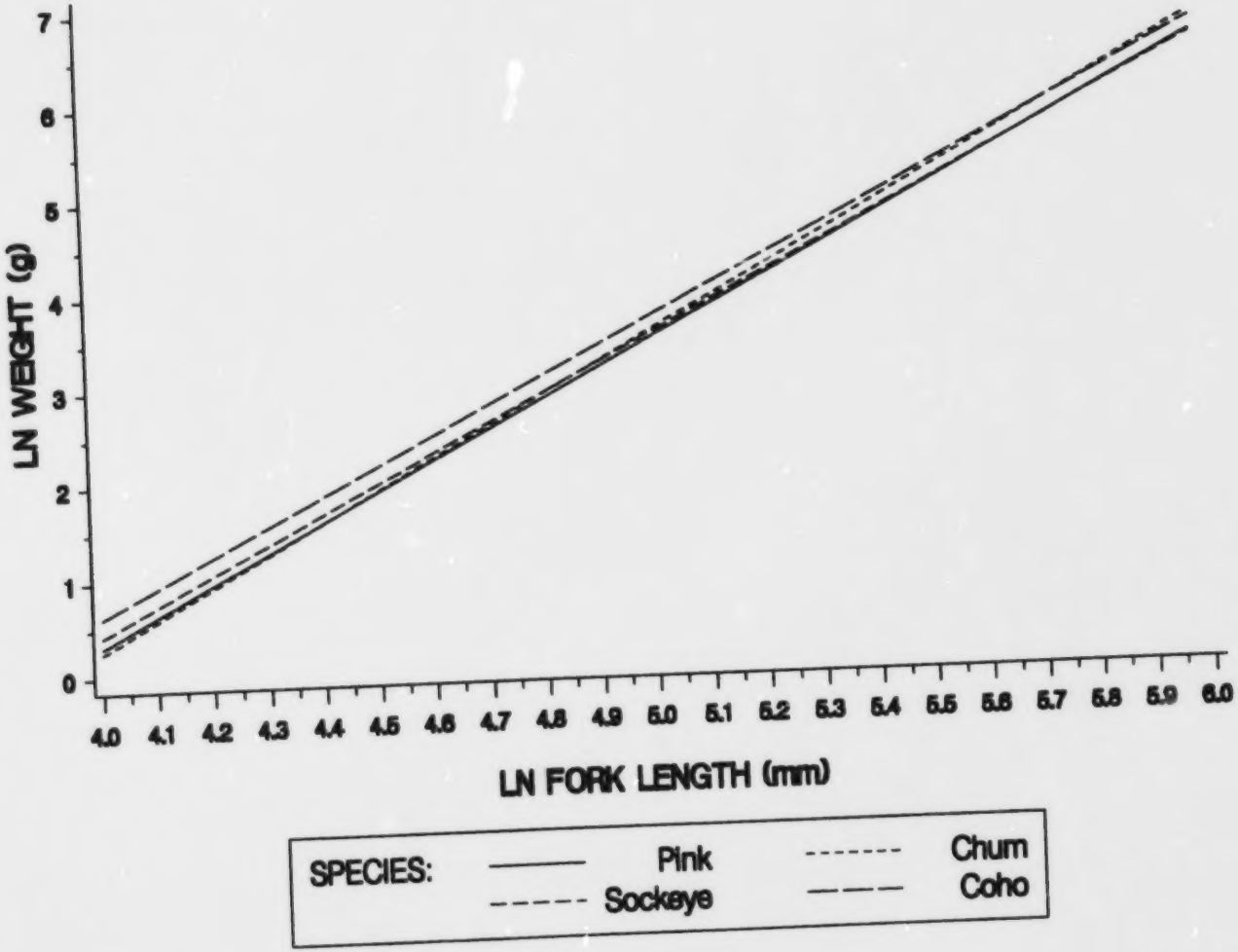
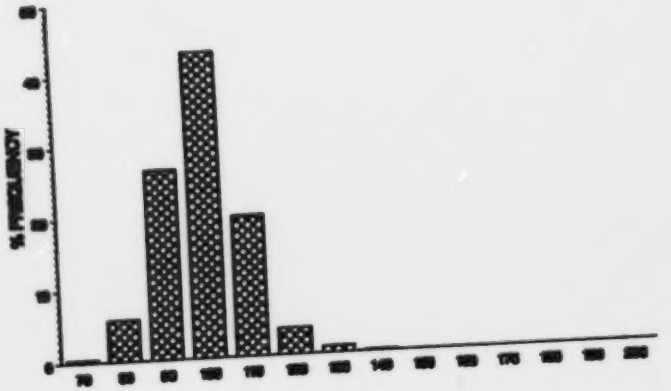


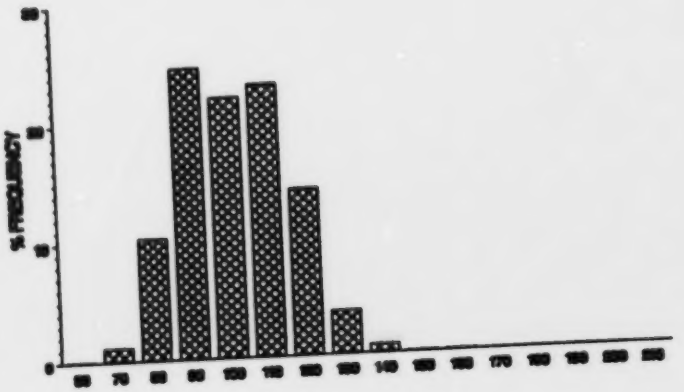
Fig. 4a. Length-frequency histograms for juvenile pink salmon from Cruise 1, 1986, Cruise 2, 1986, Cruise 1, 1987 and Cruises 2 & 3, 1987.

JUVENILE PINK SALMON

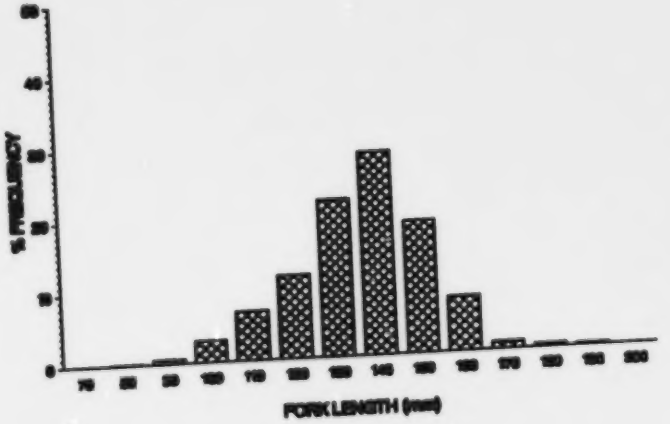
CRUISE 1 (JULY 7 – 11, 1986)



CRUISE 1 (JULY 3 – 7, 1987)



CRUISE 2 (JULY 31 – AUG. 2, 1986)



CRUISE 2 & 3 (AUG. 13 – 14 & 19 – 20, 1987)

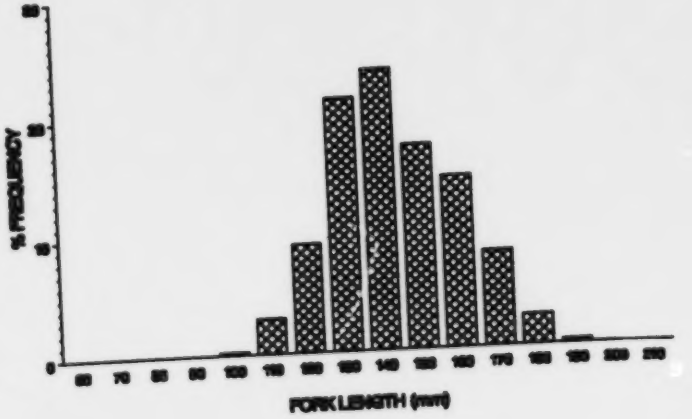
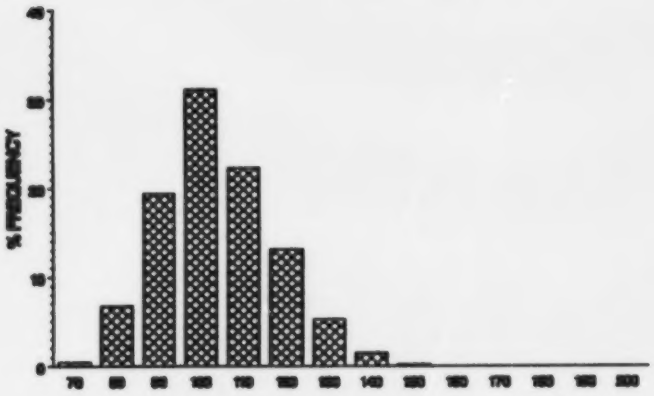


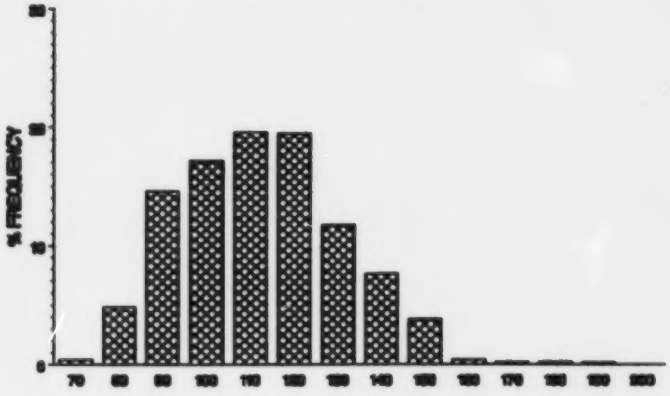
Fig. 4b. Length-frequency histograms for juvenile chum salmon from Cruise 1, 1986, Cruise 2, 1986, Cruise 1, 1987 and Cruises 2 & 3, 1987.

JUVENILE CHUM SALMON

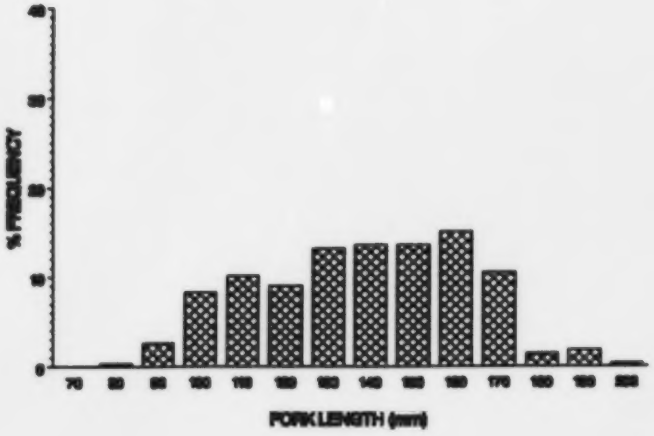
CRUISE 1 (JULY 7 – 11, 1986)



CRUISE 1 (JULY 3 – 7, 1987)



CRUISE 2 (JULY 31 – AUG. 2, 1986)



CRUISE 2 & 3 (AUG. 13 – 14 & 19 – 20, 1987)

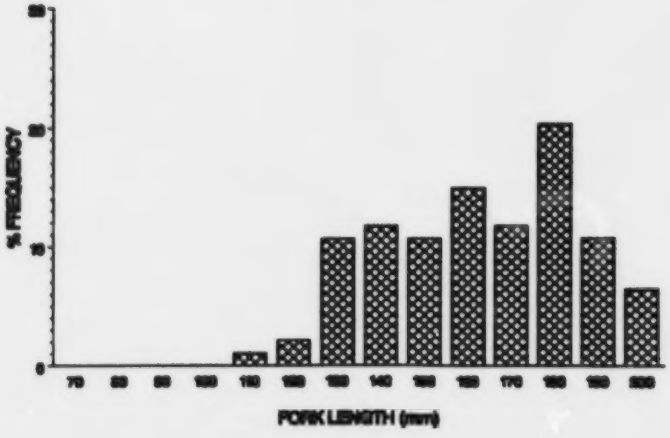
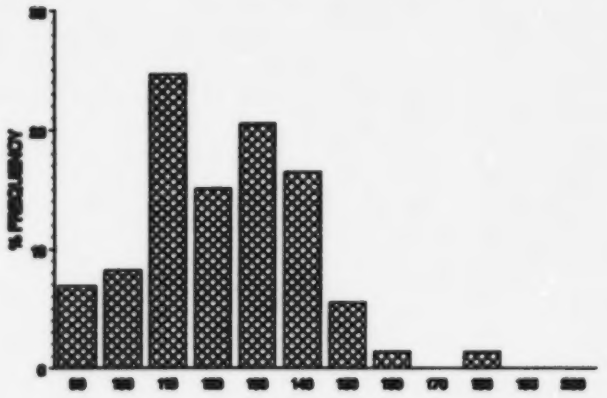


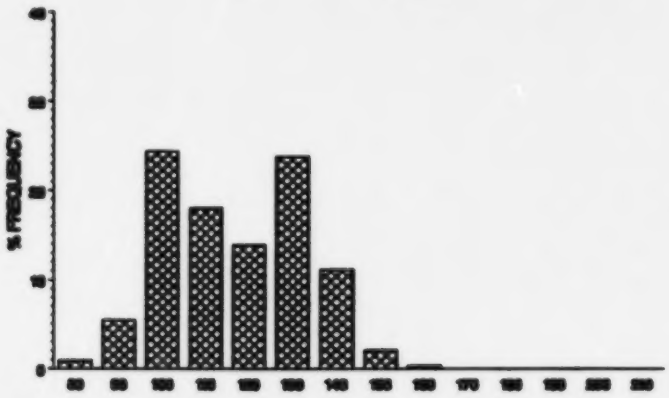
Fig. 4c. Length-frequency histograms for juvenile sockeye salmon from Cruise 1, 1986, Cruise 2, 1986, Cruise 1, 1987 and Cruises 2 & 3, 1987.

JUVENILE SOCKEYE SALMON

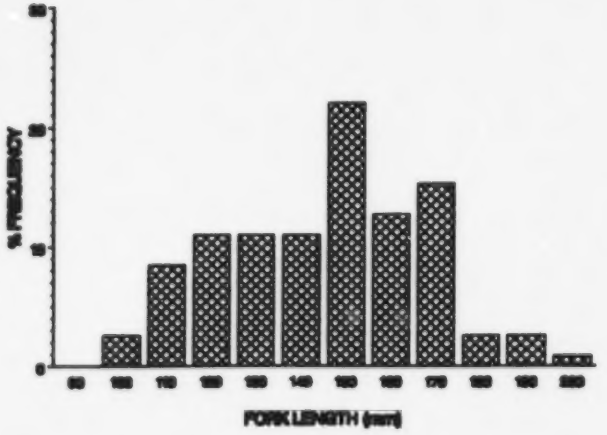
CRUISE 1 (JULY 7 – 11, 1986)



CRUISE 1 (JULY 3 – 7, 1987)



CRUISE 2 (JULY 31 – AUG. 2, 1986)



CRUISE 2 & 3 (AUG. 13 – 14 & 19 – 20, 1987)

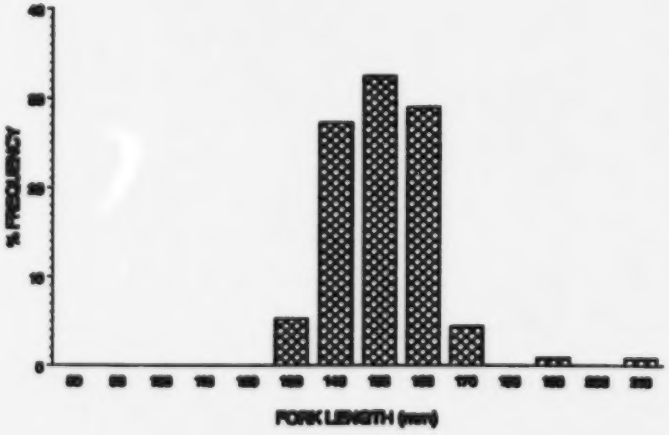
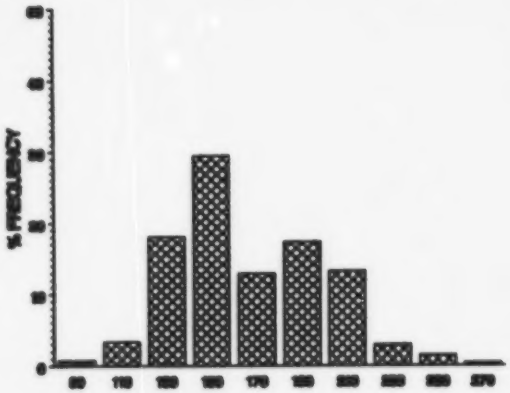


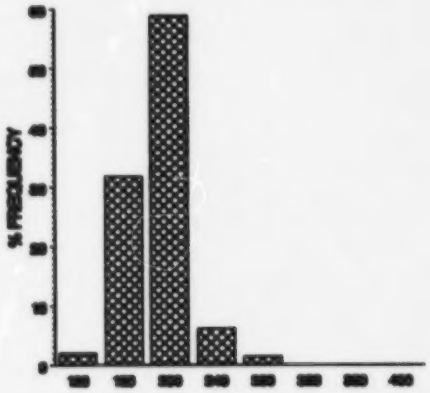
Fig. 4d. Length-frequency histograms for juvenile coho salmon from Cruise 1, 1986, Cruise 2, 1986, Cruise 1, 1987 and Cruises 2 & 3, 1987.

JUVENILE COHO SALMON

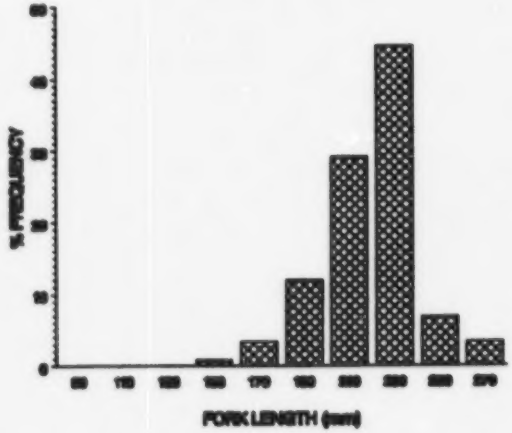
CRUISE 1 (JULY 7 – 11, 1986)



CRUISE 1 (JULY 3 – 7, 1987)



CRUISE 2 (JULY 31 – AUG. 2, 1986)



CRUISE 2 & 3 (AUG. 13 – 14 & 19 – 20, 1987)

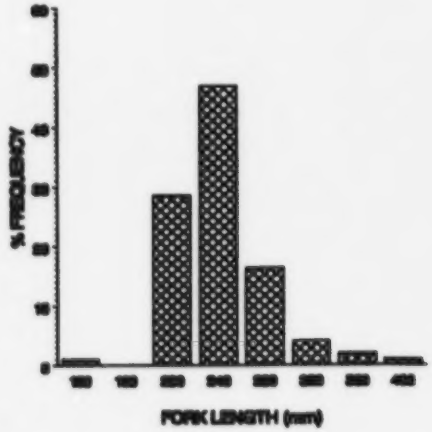


Fig. 5. 1986 juvenile coho mean fork lengths (mm) at 5 distance intervals offshore (INSIDE = Inside Channels; 3-8 km; 9-16 km; 17-24 km and >25 km) during Cruise 1 (July 7-11) and Cruise 2 (July 31 - Aug. 2).

Cruise x distance interaction factor:	F = 0.25	P>F = 0.7805
Cruise timing factor:	F = 680.36	P>F = <0.0001
Distance offshore factor:	F = 125.73	P>F = <0.0001

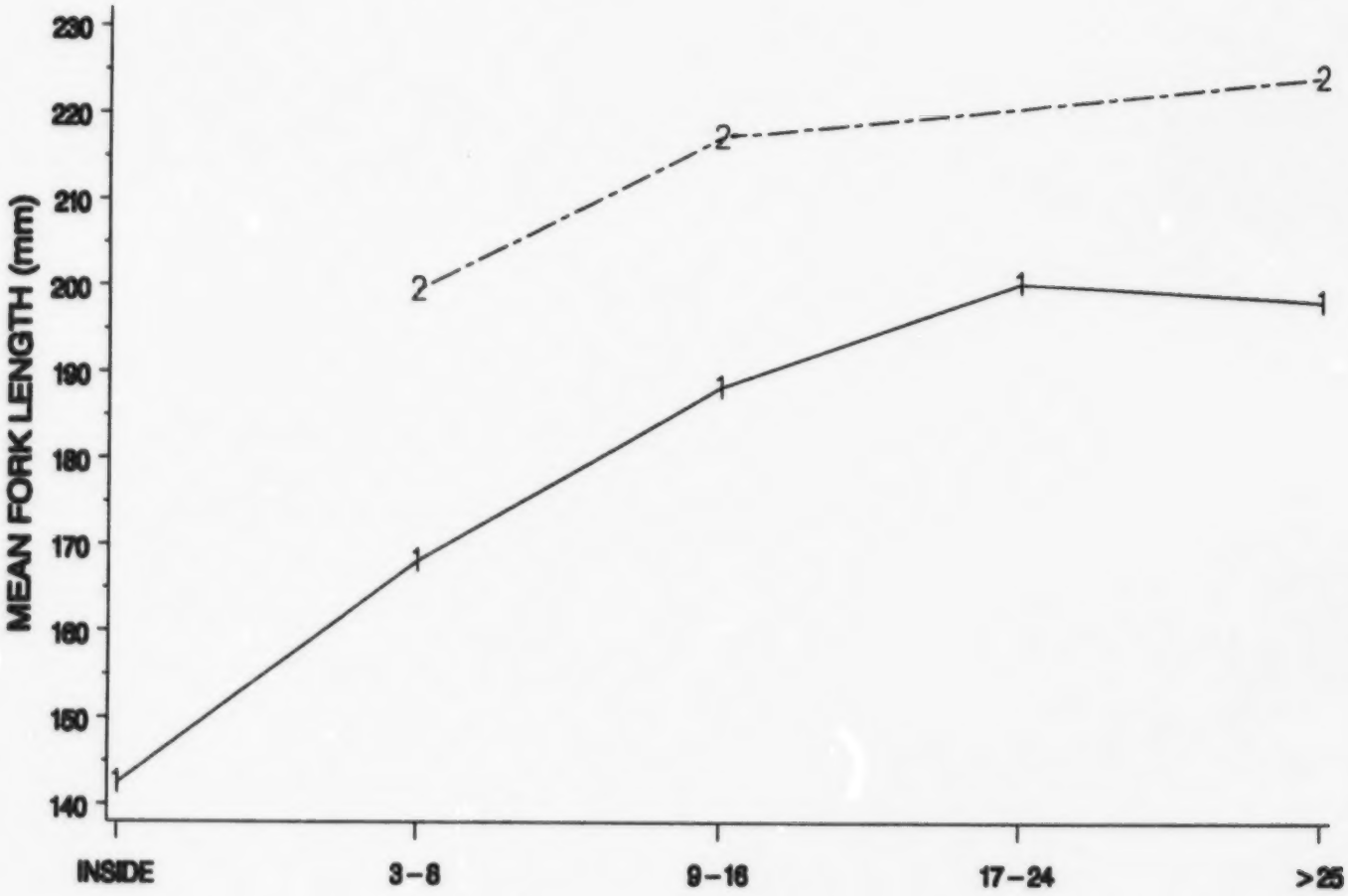

MEAN FORK LENGTH (mm)
230
220
210
200
190
180
170
160
150
140
INSIDE
3-8
9-16
17-24
>25
DISTANCE OFFSHORE (km)
LEGEND: 1 = Cruise 1(July 7-11) 2 = Cruise 2(July 31 - Aug. 2)

Fig. 6a. Correlation of juvenile pink and juvenile chum mean fork lengths (mm) during Cruise 1, 1986 (July 7-11).

PINK VS. CHUM FORK LENGTHS
CRUISE 1 (JULY 7 – 11, 1986)

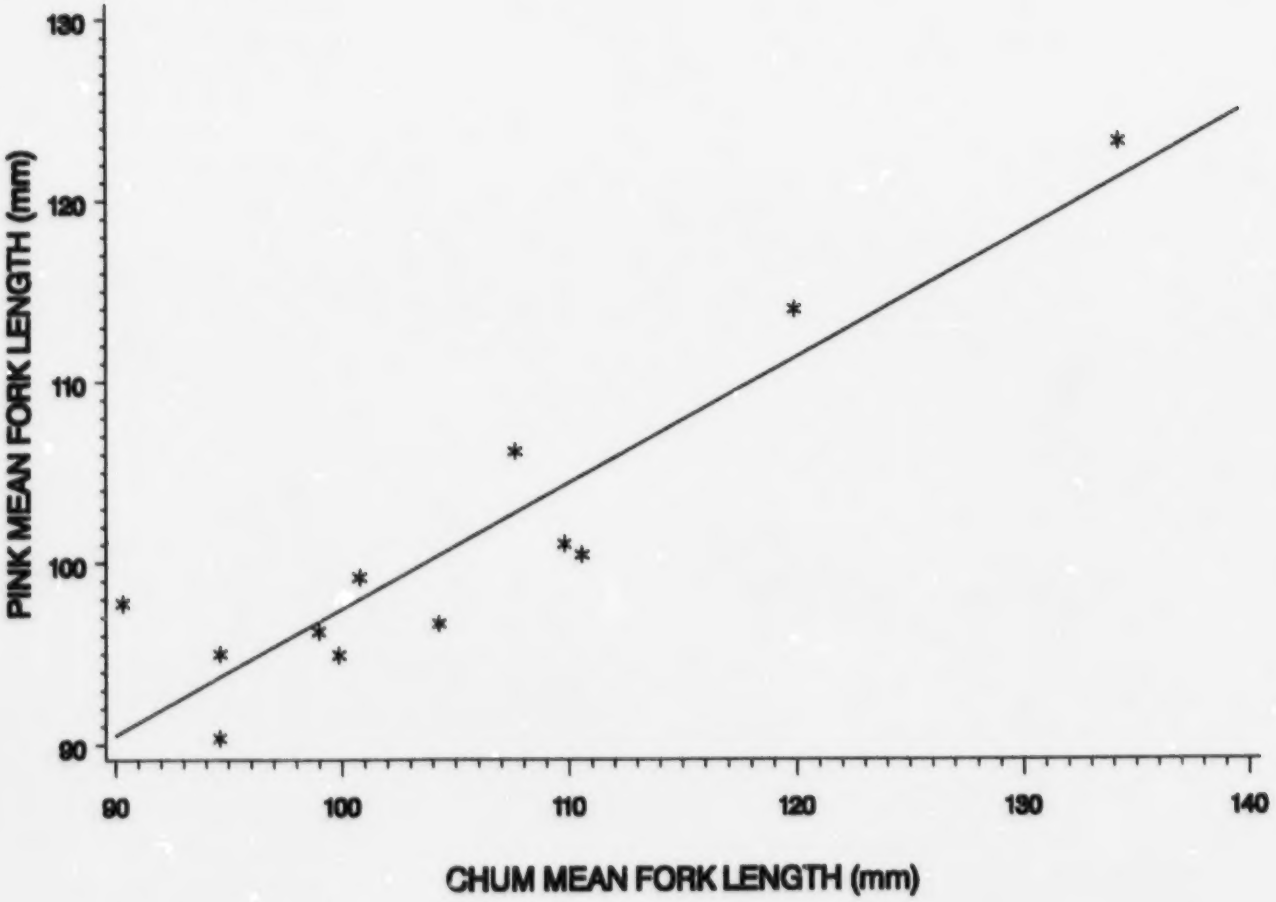


Fig. 6b. Correlation of juvenile pink and juvenile chum mean fork lengths (mm) during Cruise 2, 1986 (July 31 - Aug. 2).

PINK VS. CHUM FORK LENGTHS
CRUISE 2 (JULY 31 – AUG. 2, 1986)

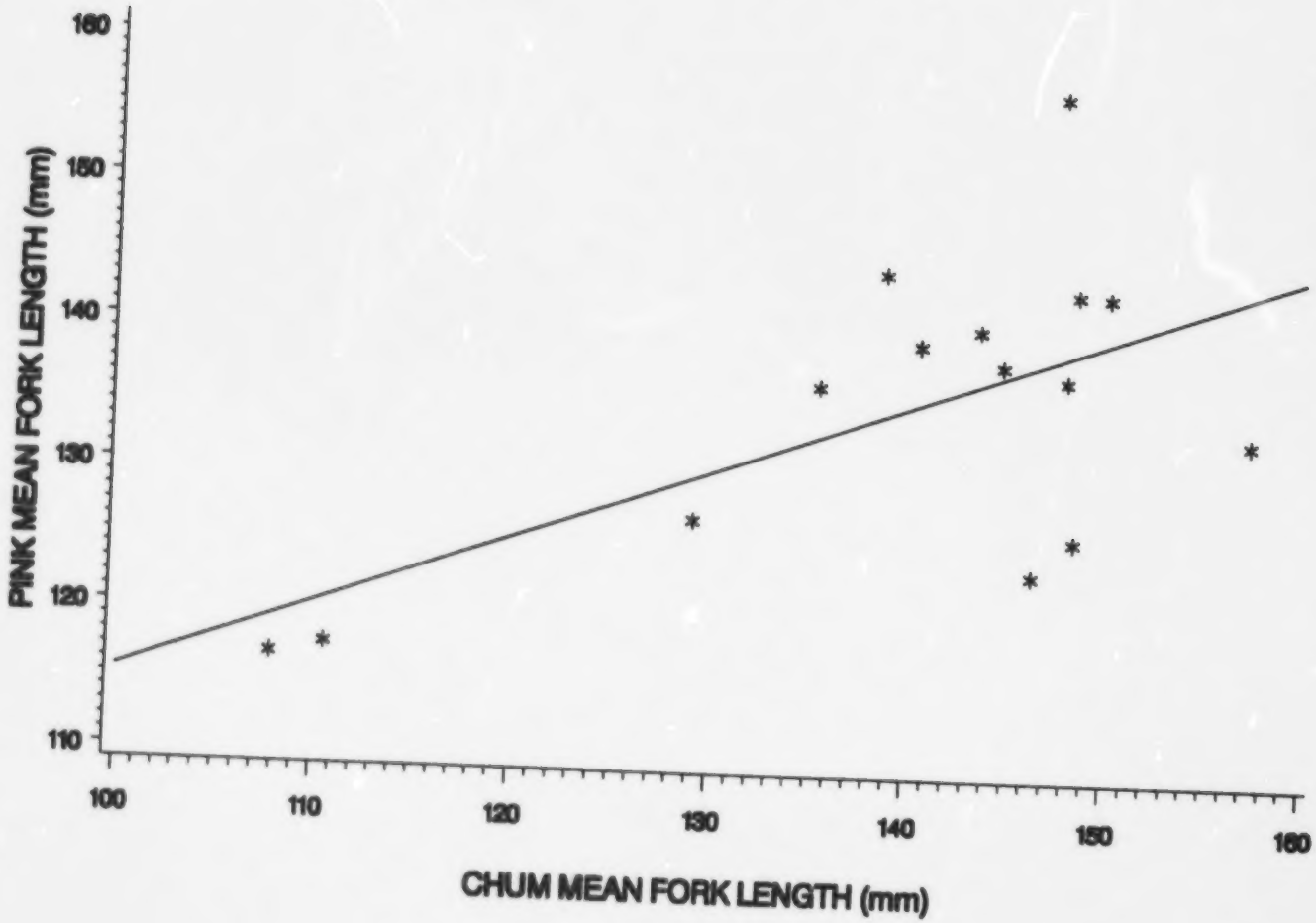


Fig. 6c. Correlation of juvenile pink and juvenile chum mean fork lengths (mm) during Cruise 1, 1987 (July 3-7).

PINK VS. CHUM FORK LENGTHS

CRUISE 1 (JULY 3 – 7, 1987)

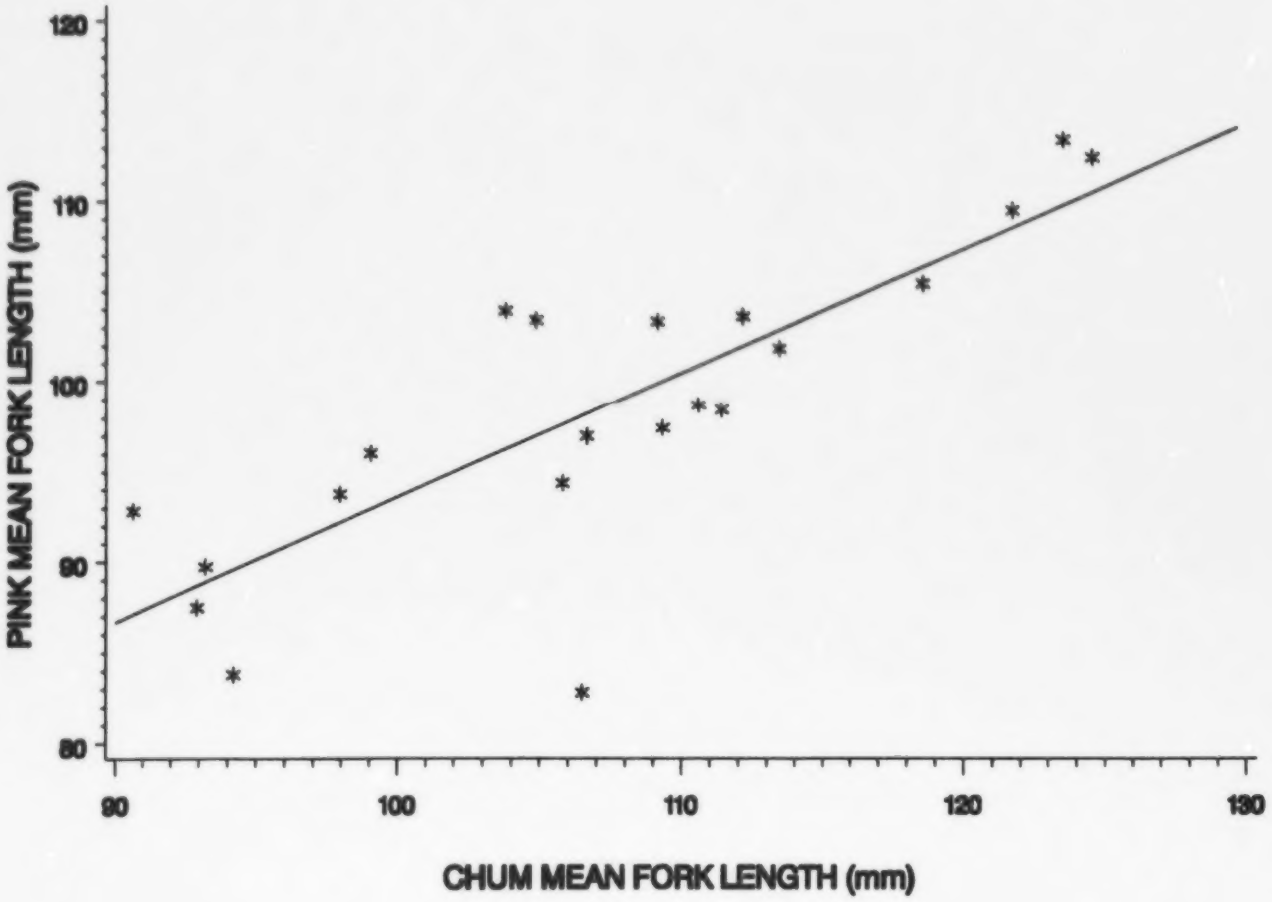


Fig. 6d. Correlation of juvenile pink and juvenile chum mean fork lengths (mm) during Cruise 2 and 3, 1987 (Aug. 13-14 and Aug. 19-20).

PINK VS. CHUM FORK LENGTHS

CRUISES 2 & 3 (AUG. 13 – 14 & 19 – 20, 1987)

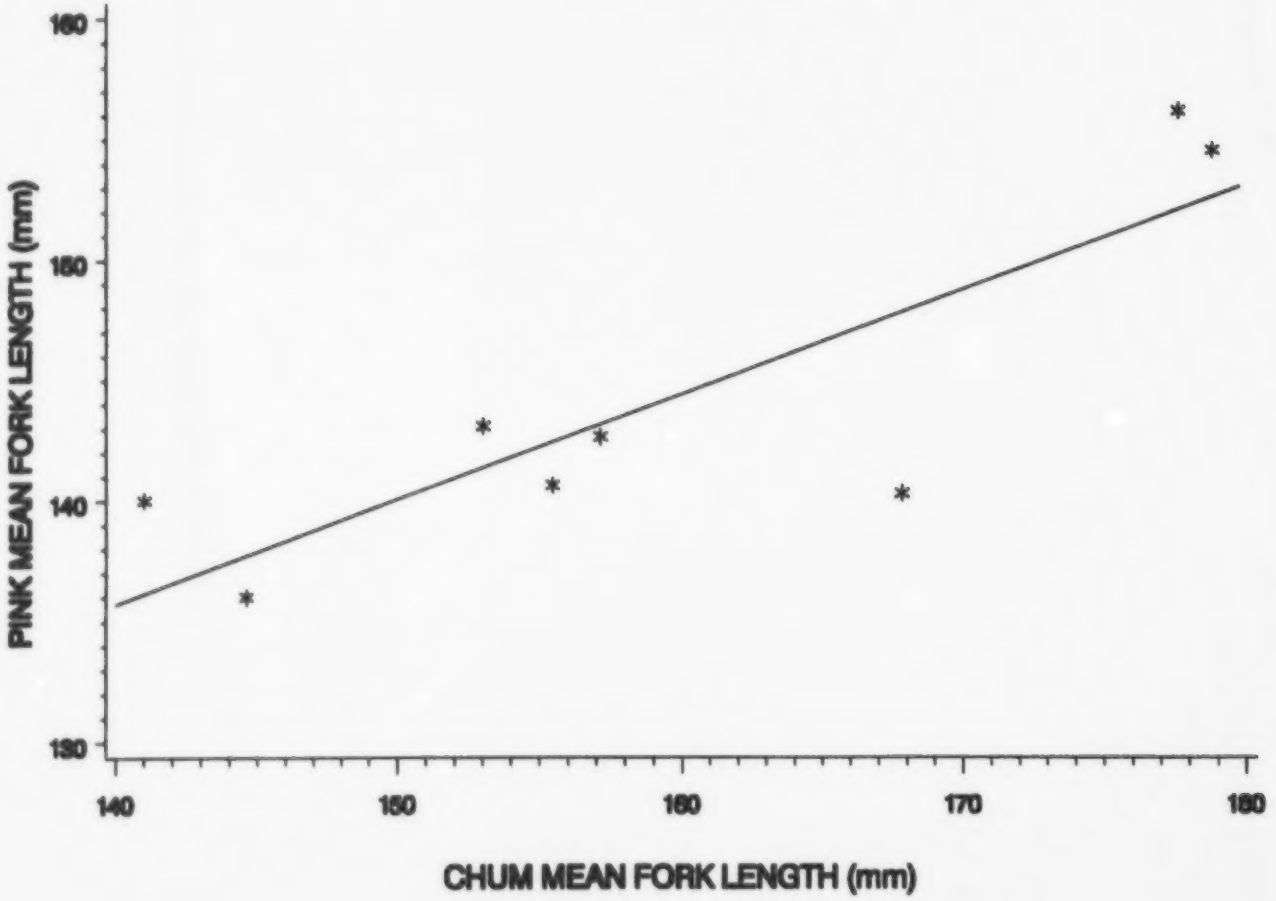


Fig. 7a. Correlation of the capture of juvenile pink and the capture of juvenile chum salmon during Cruise 1, 1986 (July 7-11; CPUE = No./set).

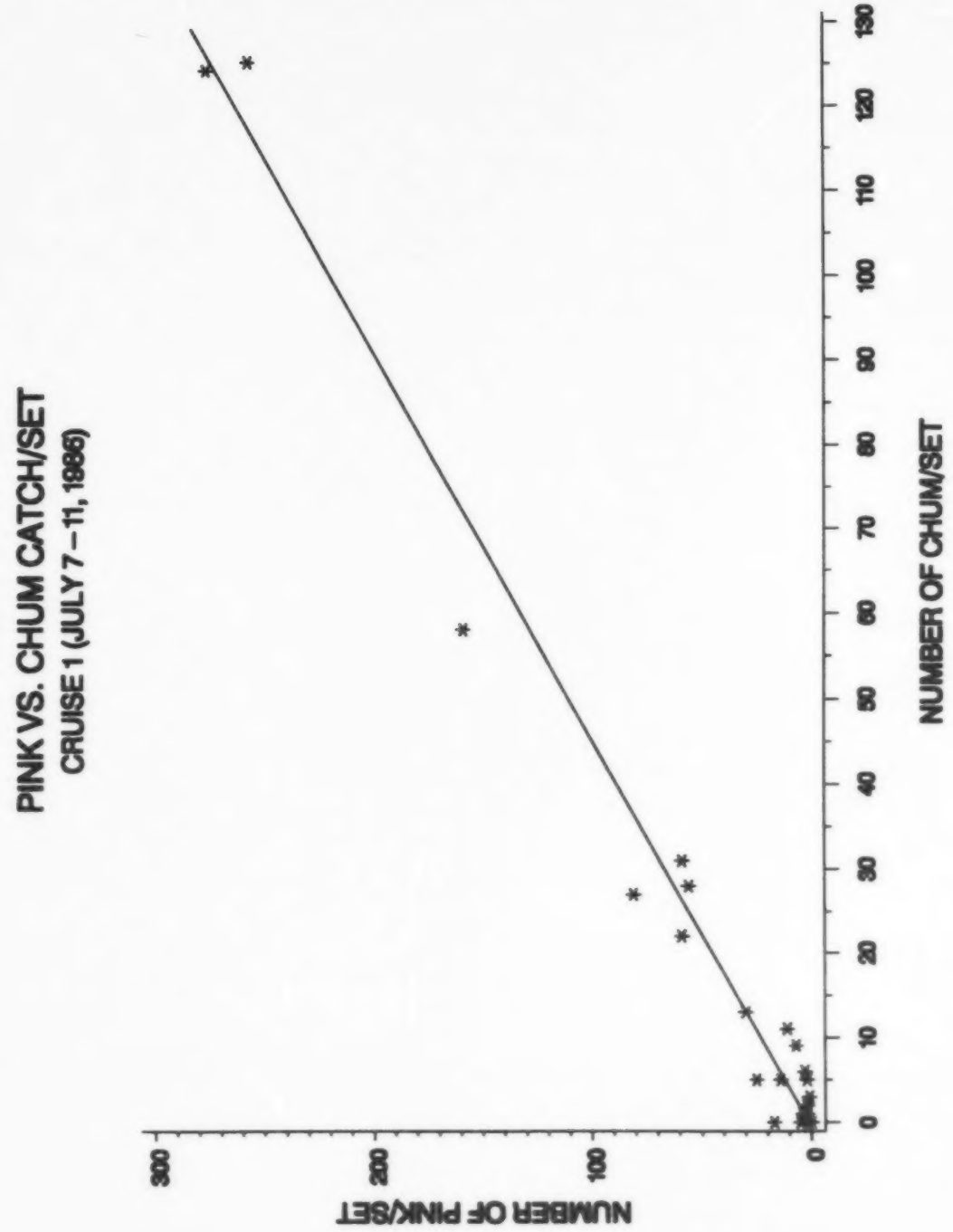

PINK VS. CHUM CATCH/SET
CRUISE 1 (JULY 7 – 11, 1986)
NUMBER OF PINK/SET
NUMBER OF CHUM/SET
0
100
200
300
0
10
20
30
40
50
60
70
80
90
100
110
120
130

Fig. 7b. Correlation of the capture of juvenile pink and the capture of juvenile chum salmon during Cruise 2, 1986 (July 31 - Aug. 2; CPUE = No./set).

PINK VS. CHUM CATCH/SET

CRUISE 2 (JULY 31 – AUG. 2, 1986)

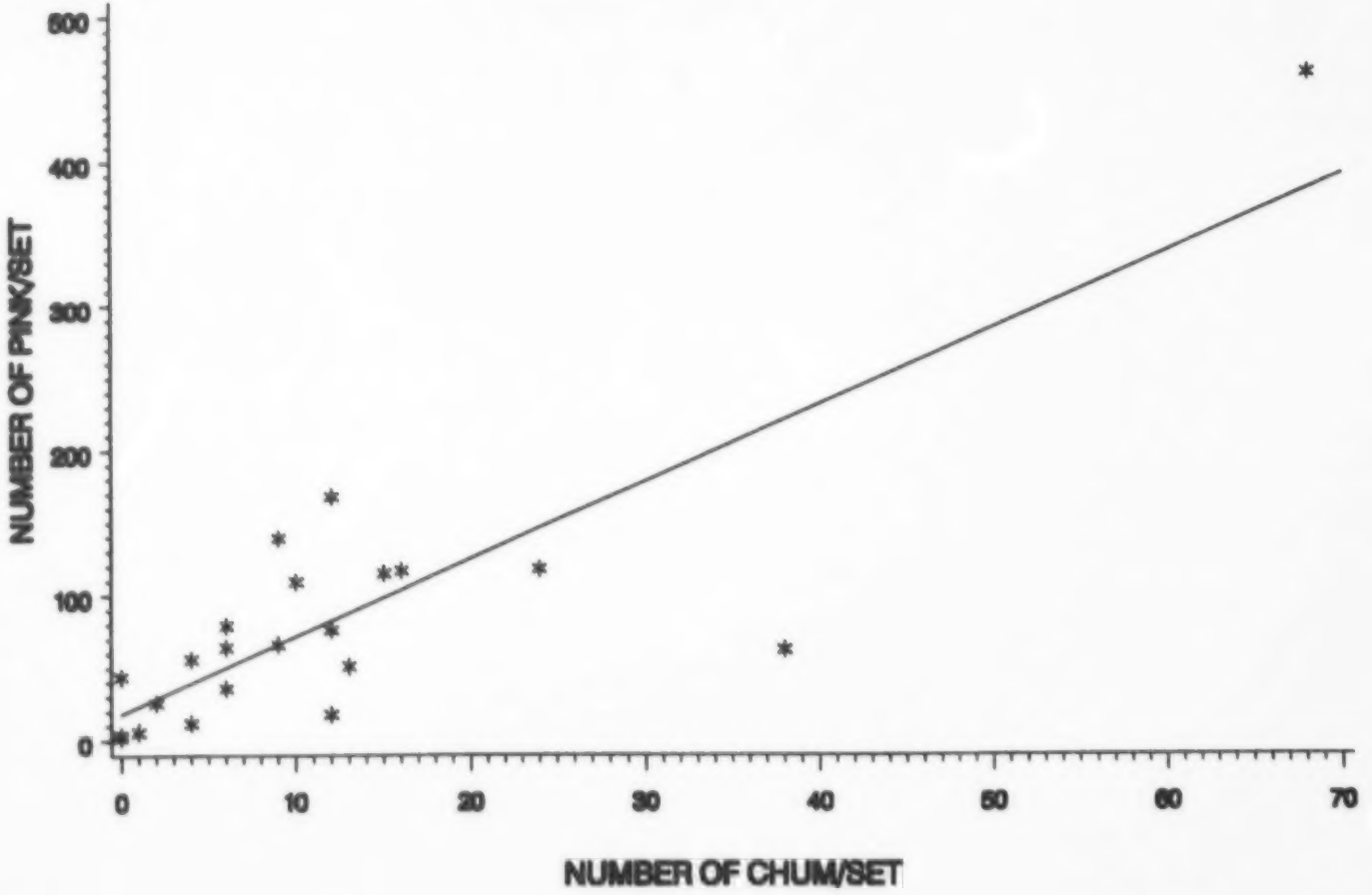
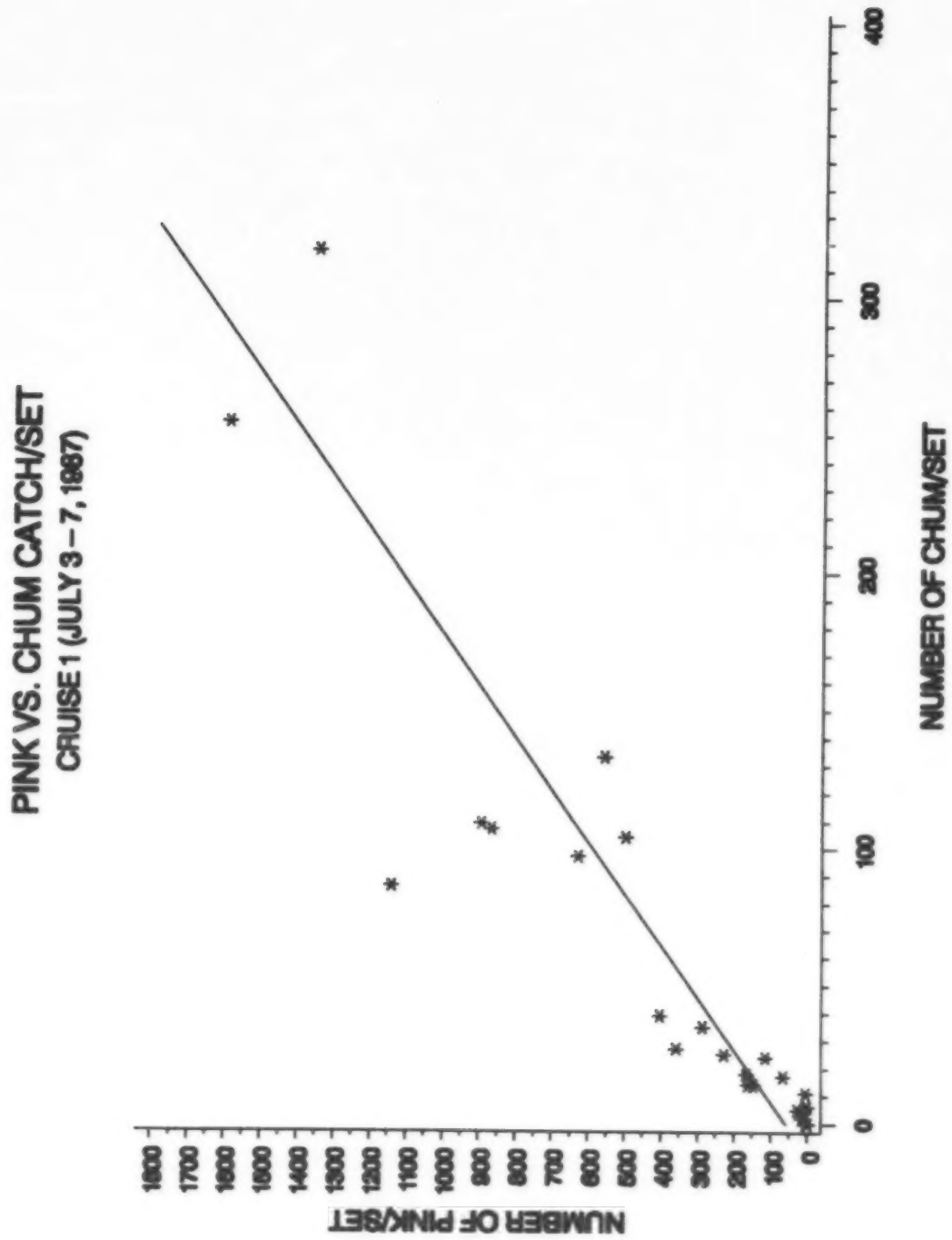


Fig. 7c. Correlation of the capture of juvenile pink and the capture of juvenile chum salmon during Cruise 1, 1987 (July 3-7; CPUE = No./set).


PINK VS. CHUM CATCH/SET
CRUISE 1 (JULY 3 – 7, 1987)
NUMBER OF PINK/SET
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
0
100
200
300
400
NUMBER OF CHUM/SET